NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

NUTRIENT STUDY OF MESOSCALE THERMAL
FEATURES OFF POINT SUR, CALIFORNIA

by

Walter Elof Hanson, Jr.

September 1980

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Nutrient Study of Mesoscale Thermal Features Off Point Sur, California

by

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OCEANOGRAPHY

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ABSTRACT

Thermal patterns with the appearance of cyclonic motion and sharp thermal fronts frequently are seen in satellite IR images off the California coast near Pt. Sur. These thermal patterns are associated with distinctly structured upwelling systems. In nine seasonal cruises since December 1978, nutrient fronts are strongly correlated with thermal fronts. However, an upwelling which is well defined by the satellite detected thermal front, may not be nutrient rich. A strong inverse linear correlation between nutrients and temperature though does exist for upwelling within an early stage of development. It is feasible, by utilizing limited *in situ* data, to infer nutrient distribution within satellite detected, surface thermal patterns associated with upwelling.

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I. INTRODUCTION

This thesis is a study of the linear correlation of satellite detected sea surface thermal patterns to nitrate and phosphate levels in a coastal upwelling region. In part, it considers whether the chemical mesoscale in upwelling systems may be inferred from satellite IR detection of surface thermal patterns.

The Advanced Very High Resolution Radiometer (AVHRR) on the TIROS (Television Infrared Observation Satellites) satellite series can be used to locate sea surface temperature patterns which identify upwelling regions for *in situ* automated biochemical and thermal sampling and analyses. Surface temperature and nutrient maps can be generated using *in situ* measurements and inference re temperature based on synoptic satellite IR imagery and nutrient to temperature correlations.

Previous studies which used the same methods to detect and describe the thermal features (e.g., Traganza, Nestor, and McDonald, 1980) showed that some of these features resulted from upwelling pulses and produced nutrient structures of the same scale. These highly structured upwelling systems had sharp thermal and chemical gradients or fronts. The recurrent formation of a "cyclonic upwelling system" off Pt. Sur, California [Traganza, Conrad, and Breaker, 1980], offers a unique opportunity to investigate the significance of frontal systems in

regions of upwelling. Significantly higher nutrient concentrations observed in upwelling systems can enhance biological activity in the proximity of the fronts.

The ability to infer the nutrient concentrations associated with an upwelling system, identified in satellite IR imagery, might help in explaining the relationships between the chemical mesoscale and pelagic ecosystem in the region. The occurrence of microplanktonic blooms adjacent to sharp thermal and chemical gradients has been documented in many coastal upwelling regions around the world [Barber, 1980; Blasco, 1980; Boyd and Smith, 1980; Traganza, Conrad, and Breaker, 1980]. Because phytoplankton are the primary producers in the pelagic ecosystem, their productivity supports the foodweb of which man harvests primarily the higher level heterotrophs. The magnitudes of nutrient concentrations and nutrient fluxes in upwelling systems could provide clues to the biological productivity in such areas. The associated thermo-chemical gradients or fronts could become the foci for fishing efforts. With the potential for biological production known and the growth rate predicted for an ecosystem, fishing fleets could be effectively dispatched to optimize yields.

While thermal patterns may correlate well with satellite observations, correlations for chemical patterns with IR imagery are by inference and may be less simple, tending to vary as a function of the initial conditions, boundary

conditions, biological processes, and the dynamic processes acting over time. An understanding of all these processes may be necessary to translate satellite thermal patterns into nutrient levels.

The objectives of this thesis are:

1. To investigate the linear relationship between *in situ* values of nutrients (nitrate and phosphate) and temperature associated with coastal upwelling occurring under varying nutrient and temperature characteristics of the ambient water mass and stages of development.

2. To map observed values of temperature, nitrate, phosphate, and nutrient ratio (nitrate/phosphate).

3. To compare the magnitudes and gradients of temperature and nutrients associated with the oceanic front in different types of upwelling in different stages of development.

4. To examine the relationship between the surface temperatures and nutrient concentrations in recently upwelled water and to estimate the depth from which it advected.

5. To test the accuracy of a satellite-aided prediction in which the source water temperature and nutrient characteristics are used in a regression equation to hindcast surface nutrient concentrations.

II. METHODS

A. STUDY AREA

The study area (Fig. 1) extends *ca*. 30 km north of Pt. Sur and *ca*. 60 km to the south. It is bounded by the 122° 30' W meridian and the Central California coastline stretching from Monterey to Cape San Martin.

B. CRUISES

Three cruises were conducted aboard the Naval Postgraduate School's research vessel R/V ACANIA, 27 and 28 September 1979; 29 and 30 November 1970; and 10 and 11 June 1980. Positions were determined by LORAN-C which has good coverage in this region. Running plots of temperature and nitrate and phosphate concentrations were maintained and used to ensure coverage of features of interest. Particular attention was given to the location of thermal gradients observed in satellite images received prior to each cruise.

C. SURFACE SEAWATER SAMPLING SYSTEM

Seawater was continuously sampled from a depth of 2.5m. The September and November cruises pumped seawater from a keel intake via the ship's pump to the shipboard laboratory. The June cruise used an overboard nylon hose intake at 2.5m, which was attached to a deck-mounted Wilden, M-4, air operated diaphragm pump (Wilden Pump and Engineering Company,

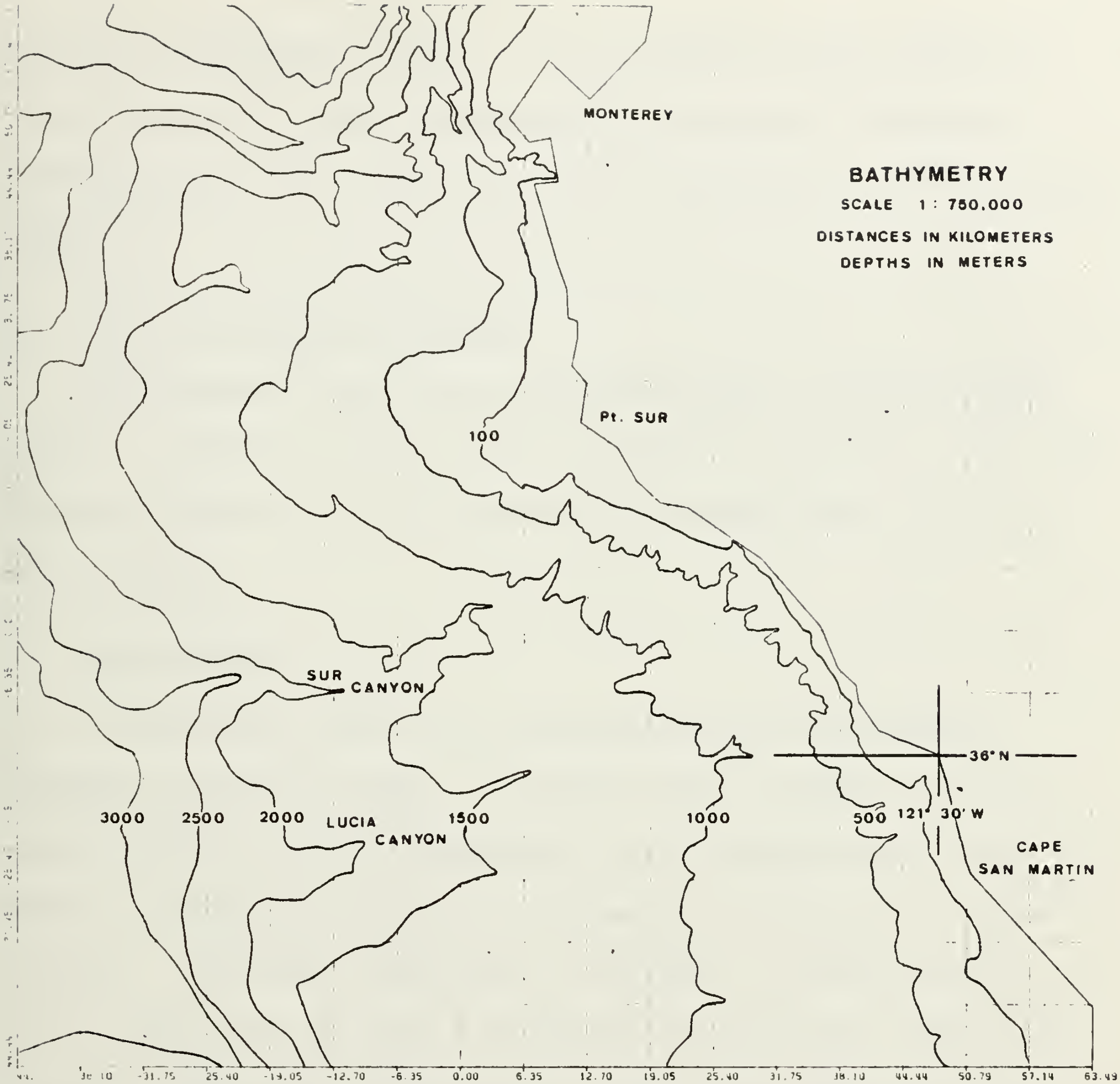


Fig. 1. Bathymetry of the study area with grid superimposed.

Colton, California 92324). An air debubbler was used in line between the pump and measuring equipment [Technicon Autoanalyzer, AA-II and Turner III Fluorometer; see Bronsink, 1980].

D. VERTICAL PROFILE SAMPLING

Seven Nansen casts were conducted also on the November cruise. Seawater samples were collected at 25, 50, 100, 200, 300, and 400 meters for analysis of temperature, salinity, and nitrate.

E. TEMPERATURE

A thermistor sensed the temperature of the seawater entering the keel intake. A strip chart recorder continuously plotted it. The equipment was calibrated and monitored every 30 minutes by bucket thermometer readings of the sea surface. The mean difference, T(bucket) - T(thermistor), of 0.1°C (std. dev. $\pm$0.2°C) was determined for the temperature. Sippican expendable bathythermograph (XBT) probes were released every 20 minutes, or *ca*. every 5 km, during the September cruise. The September 1979 and June 1980 cruises dropped XBT probes only in areas of major interest. A spacing of *ca*. 5 km was maintained along the major axis of the feature and during front transits. For calibration, sea surface temperature was measured by bucket thermometer simultaneously with the launch of each XBT probe. The mean

difference, T(bucket) - T(probe), between surface measurements was 0.0°C (std. dev. ±0.2°C).

F. NUTRIENTS

Surface (2.5m) nutrient concentrations were analyzed every two minutes according to the Technicon Industrial Method 175-72-WM, 177-72-WM [Anonymous, 1973] and 100-70-WM [Anonymous, 1978]. Nitrate here may include traces of *in situ* nitrite, since the nitrate is reduced to nitrite before measurement. However, according to Paulson [1972] there is little or no nitrite at the surface sampling depth in this area.

G. LINEAR REGRESSION AND CORRELATION COMPUTATIONS

Regression lines were generated for nitrate versus phosphate, nitrate versus temperature, phosphate versus temperature, and nutrient ratio (nitrate/phosphate) versus temperature. The linear regression analysis used the NORLSQ library subroutine from the W.R. Church Computer Center at the Naval Postgraduate School.

The population correlation coefficient was derived by the equation:

$$r = \frac{n\Sigma x_i y_i - (\Sigma x_i)(\Sigma y_i)}{([n\Sigma x_i^2 - (\Sigma x_i)^2][n\Sigma y_i^2 - (\Sigma y_i)^2])^{\frac{1}{2}}}$$

When a "none detected" condition occurred due to concentrations below the sensitivity of the instrument, the nutrient and temperature data were not used in the calculations.

H. SATELLITE IMAGERY

The AVHRR has a temperature resolution of .5°C within the IR (10.5 μm to 12.5 μm) spectral window and a spatial resolution of 1.1 km. The thermal energy measured by the AVHRR is primarily a function of radiation emitted from the upper millimeters of the sea surface, clouds, and atmospheric gases. The greatest errors in estimating sea surface temperature are induced by atmospheric attenuation of the thermal energy due to absorption and scattering. The effect of absorption by moisture in the atmosphere presents the most severe problem because of the magnitude of absorption and the variability of the moisture field. At mid-latitudes over the ocean, this attenuation may result in measurements that are 2 to 6°C lower than actual sea surface skin temperatures [Maul and Sidran, 1973].

The AVHRR has a temperature response from _ca_. -90 to 60°C. The measured thermal energy is normally displayed as gray tones on photographic film to produce images interpretable as clouds, land, and water. The colder temperatures within these images are assigned lighter shades of gray. Image enhancement reduced the range of temperatures to those representative of the sea surface, while retaining all the gray tones [see Methods: Satellite Assisted Sampling Strategy]. In the enhancement of the TIROS-N images (Plates 1, 2, and 3) a temperature range representative of the _in situ_ range of values was assigned to shades of gray with white equal

to *ca*. 7°C and black *ca*. 22°C. Studying satellite images alone is subjective because of the inability to assign temperature values representative of the sea surface to each gray shade. However, the relative temperature values and thermal gradients are more representative of *in situ* measurements within the same image than are absolute values. Because of the atmospheric effects on the thermal energy reaching the satellite, these measurements can best be described as "apparent temperatures."

I. SATELLITE ASSISTED SAMPLING STRATEGY

Approximately one week prior to each scheduled departure, Mr. Breaker, the staff oceanographer at the National Environmental Satellite Service (NESS), in Redwood City, California, would be alerted. He closely monitored images of TIROS-N satellite series for oceanic features of interest in the study area. The images were computer enhanced by him to better delineate sea surface thermal patterns. All images had the non-linear distortion associated with the earth's curvature and rotation removed. The day prior to the cruise and sometimes during the cruise, Mr. Breaker sent updated satellite information regarding the approximate location, center, size, and orientation of the feature. When possible, the most useful and most recent images were delivered prior to sailing. All proved invaluable in locating features and planning sampling strategy.

J. SATELLITE ASSISTED MAPPING OF SURFACE TEMPERATURE

Two objective temperature fields were drawn by the CONISD computer program; one field was formed from only in situ temperature, the other included data from satellite imagery as well.

The size of the study area was small enough that the spherical distortion attributed to the earth's curvature was assumed to be negligible. Therefore, the author constructed a grid on the assumed planar surface (see Appendix C) with the head of the Sur submarine canyon as its origin (Fig. 1). Each in situ data point had cartesian coordinates assigned. Using this annotated data, the CONISD library subroutine from the W.R. Church Computer Center drew surface contours. Because the contouring computations involved a triangulation process between data points nearest the limits of the grid and the study area boundaries, it was necessary to assign ocean and near coast boundary values that were realistic to generate a surface map which well represented the external limits of the surface feature. These values were inferred from the thermal patterns visible in satellite IR images.

Enhanced satellite images taken during or nearest the period of in situ observation and having a cloud-free view of the study area were used. These images were taken to NESS to geographically locate the surface thermal patterns associated with the upwelling system on a transverse mercator projection of the study area. The author outlined shifts in

the gray tones, visible to the naked eye. These lines represented a subjectively determined change in the gray scale. A uniform distribution of atmospheric moisture over the small area of the surface feature was assumed. The change in gray scale could therefore be related to synoptic variations in apparent surface temperature. Mr. Breaker, with his expertise in using the Baush and Lomb Zoom Transfer Scope, transcribed the apparent thermal patterns onto the transverse mercator projection. These patterns were then transferred by the author onto the grid developed for the study area.

Using a surface temperature map generated only from _in situ_ measurements, a plot of the ship's track (to know where and when _in situ_ measurements were taken) and the synoptic thermal patterns inferred from the satellite image of the feature, the thermal patterns within the area of concentrated _in situ_ measurements were assigned temperature values equivalent to those on the surface temperature map. The satellite detected and _in situ_ thermal patterns matched well, within ±.5°C. Where these thermal patterns approached the coast, those values inferred above were applied to the near coast boundary. For objective (machine) contouring the oceanic temperature field beyond 6 km from the seaward outline of the surface thermal feature was arbitrarily assigned a uniform value. The oceanic boundary formed a curve at a constant distance (_ca_. 6 km) seaward of the surface thermal feature. The warmest _in situ_ measurement made in this oceanic region

was assigned to the oceanic boundary. With the inferred near coast and ocean boundary values and *in situ* data, another surface temperature map was generated by the CONISD subroutine. Hand smoothing was applied to reduce the distortion thought to be caused by advection or other dynamic processes over the time period of the study. These temperature surface maps appear in Figures 10, 20, and 34.

K. SURFACE NUTRIENT MAPS

The sea surface nutrient maps (Figs. 11, 12, 13, 21, 34, 35, and 36) were generated in similar fashion to the sea surface temperature map. Each *in situ* data point was assigned cartesian coordinates on the study area grid. The near coast and ocean boundary values for temperature were put into the regression equations for nitrate/temperature, phosphate/temperature, and nutrient ratio/temperature. The respective nitrate, phosphate, and nutrient ratio output were assigned to the coordinates of the input temperature. Using this annotated *in situ* and temperature inferred data, the CONISD library subroutine drew surface contours. Hand smoothing was applied to reduce the distortion thought to be caused by advection or other dynamic processes over the time period of the study.

L. DEFINITION OF FRONT AND CALCULATION OF ITS GRADIENTS

For the purpose of this thesis, the oceanic front is defined as the area where the thermal and chemical gradients

reach their maximum change per kilometer [see Discussion: The Relationship Between Source Water Characteristics and the Oceanic Front]. In order to locate the oceanic front and assess its gradients, the following procedures were carried out.

The incremental change per kilometer of nutrient concentrations and temperature was determined from the in situ values observed along the ship's track. The elapsed distance midway between the magnitudes used to compute this spatial gradient was assigned as the position on the ship's track at which the change occurred (Figs. 14, 22, and 38). This technique was used to take advantage of the high spatial resolution (better than 0.6 km) along the ship's track which showed microstructure fronts within the feature as well as the oceanic front.

The magnitude of the gradient of the front was computed after correcting for the angle at which the ship transited the front. It was assumed that the front parallels isolines of temperature and nutriend concentrations on the machine-contoured charts. The angle of incidence the ship's track intersected these isolines at the vicinity of the front was measured using surface nutrient and temperature maps. Applying the law of sines, the distance along the normal was found and used to compute the magnitude of the gradient.

III. RESULTS

A. SEPTEMBER 1979 CRUISE

This cruise investigated and verified the existence of a satellite sensed wedge-like surface thermal feature extending 100 km SW from Pt. Sur (Plate 1). From satellite images received from 18 to 26 September, it appeared that this feature formed off Pt. Sur on 18 September. By 20 September the apex of this wedge-like feature had acquired a northward, anticyclonic curvature. Between 20 and 26 September this feature became diffuse , a new coastal upwelling event commenced and a new feature was superimposed. A satellite imagery summary is presented in Figure 2. The best image of the feature (Plate 1) was taken at 2255 GMT, 26 September, ca. 2 hours prior to the ship's departure for the study area. Winds, as measured by the ship's anemometer, blew from the northwest averaging between 5 and 7 $m \cdot sec^{-1}$.

The objectives of this cruise were to obtain surface samples from the feature and its oceanic surroundings, to sample both day and night to minimize diel effects, and to maximize time near the cold core of the feature. A seven-pointed star track was planned (Fig. 3) using thermal pattern information derived from satellite IR imagery. Temperature, nitrate, and phosphate are plotted over elapsed distance in Figure 4. Correlation coefficients of r = 0.78 for nitrate

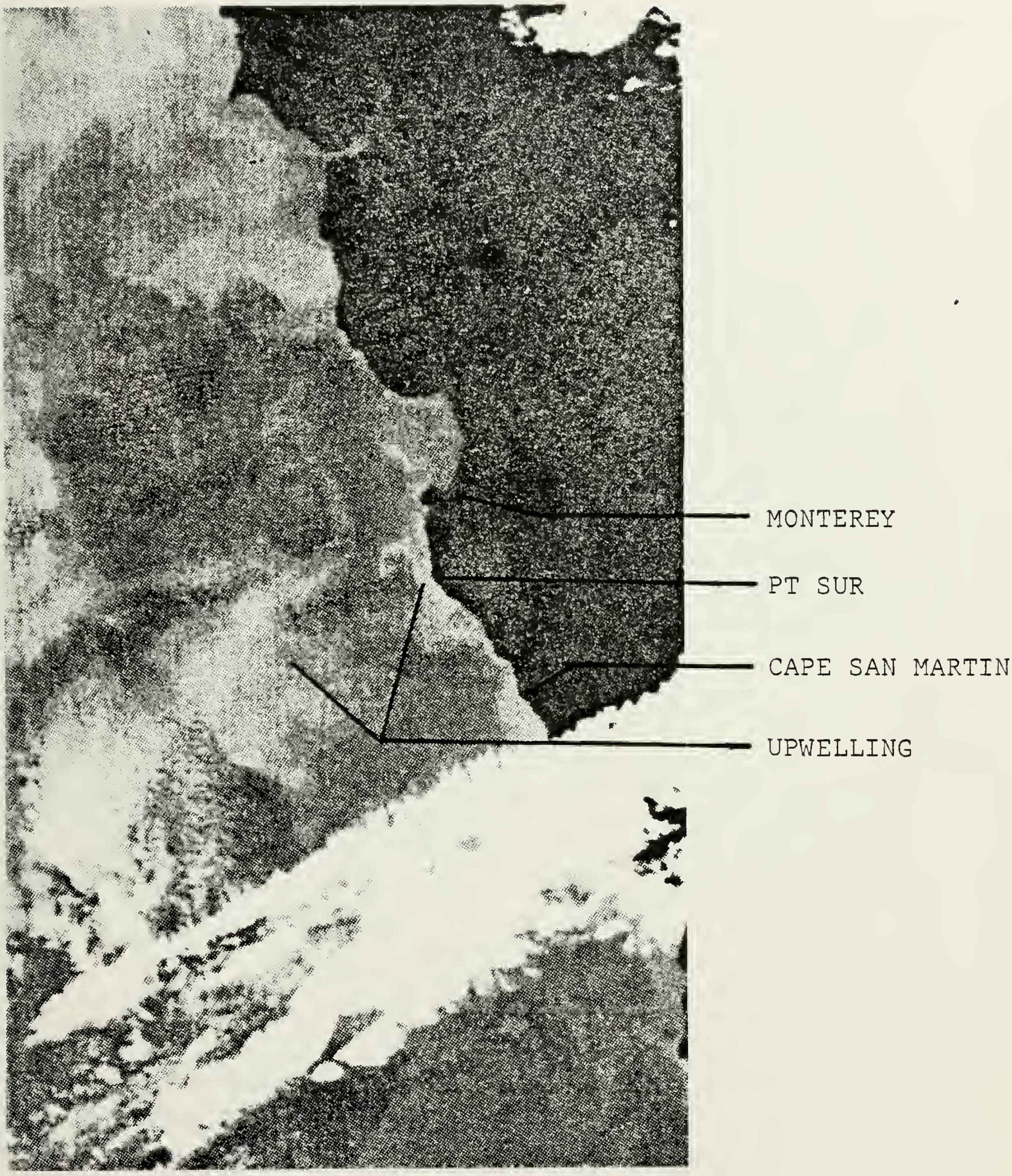


Plate 1. TIROS-N satellite IR image of the California coast for 26 September 1980.

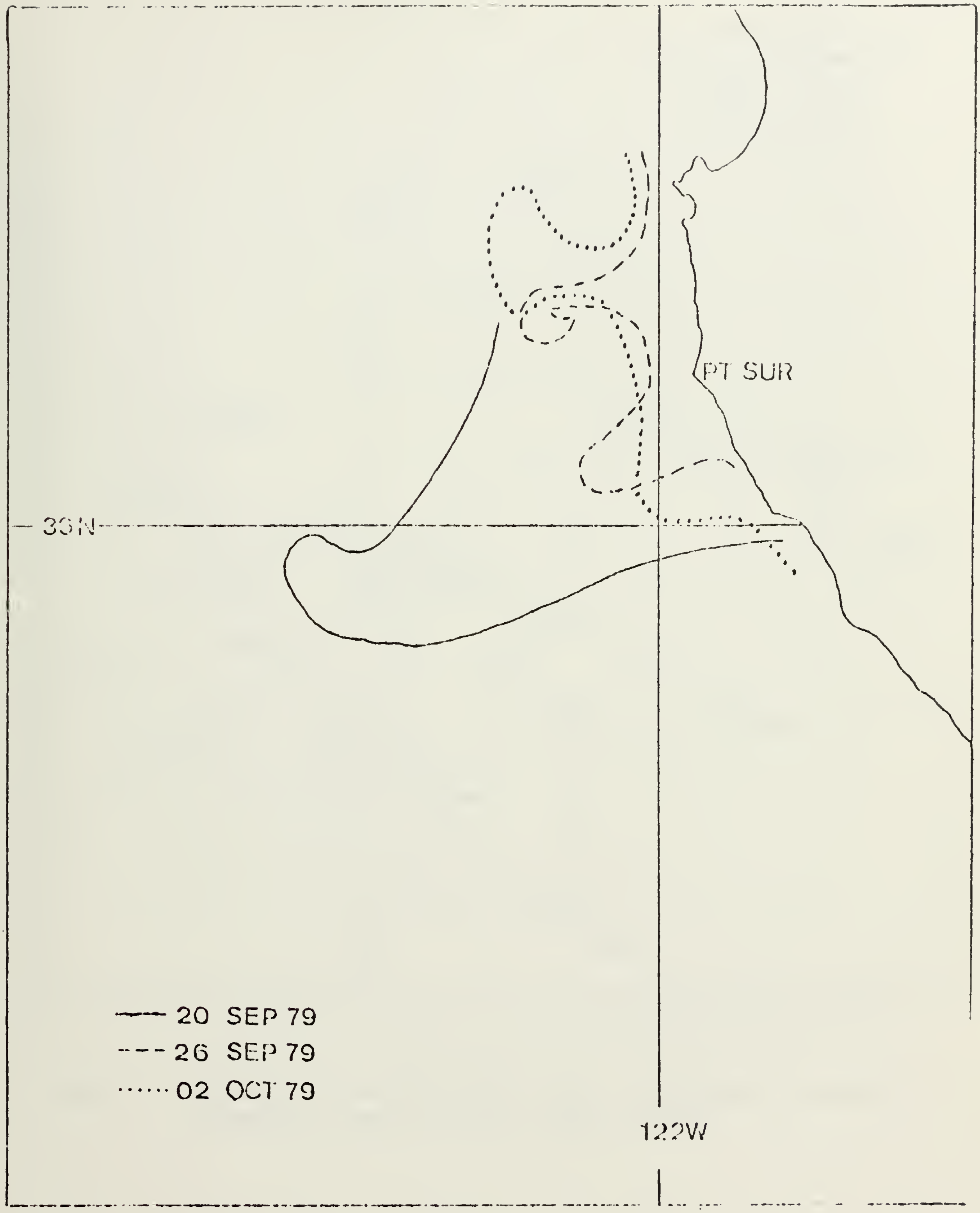


Fig. 2. Satellite features observed from 20 September to 2 October 1979 [Johnson, 1980].

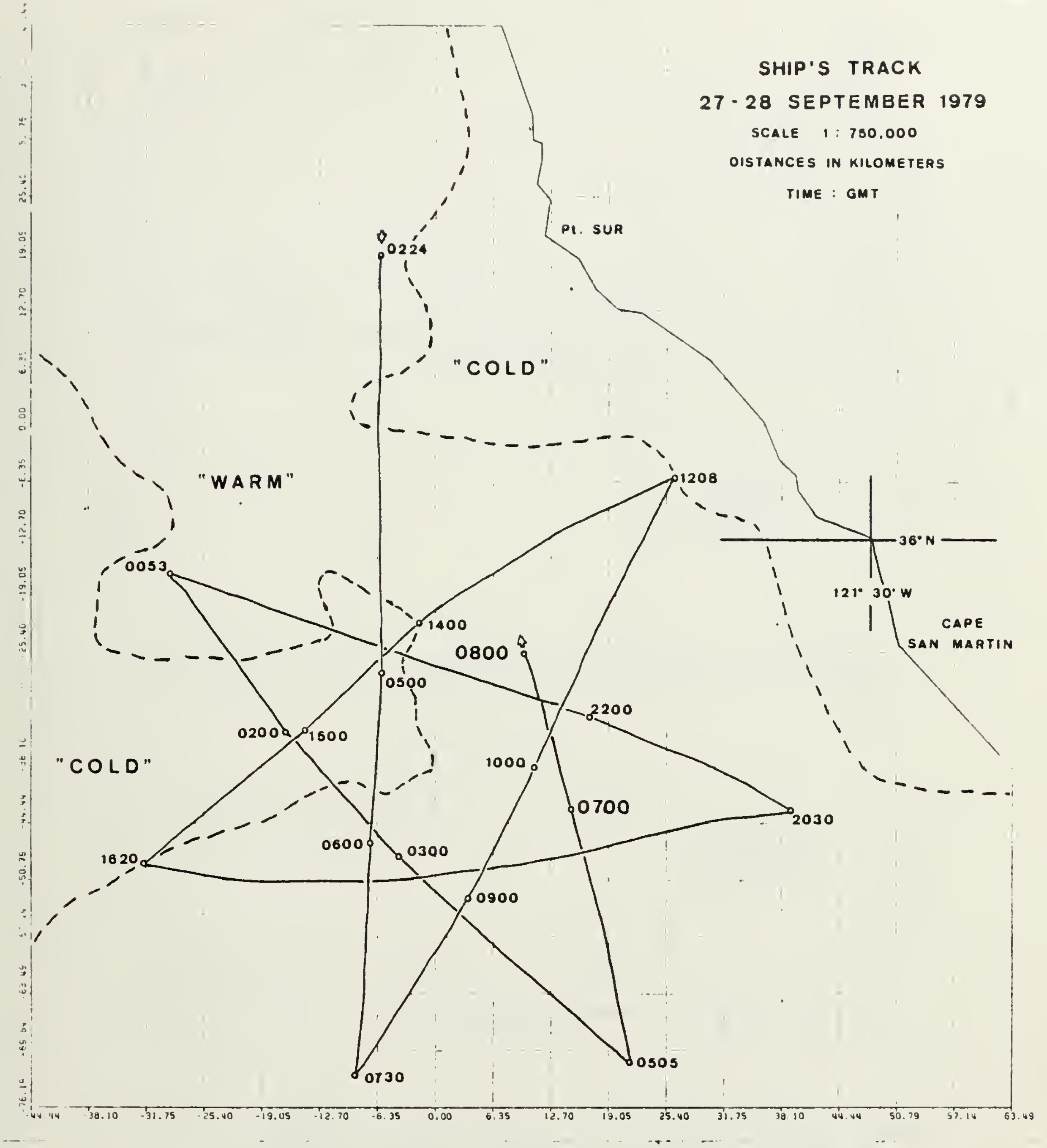


Fig. 3. Track of the September 1979 cruise and outline (dashed line) of the oceanic front.

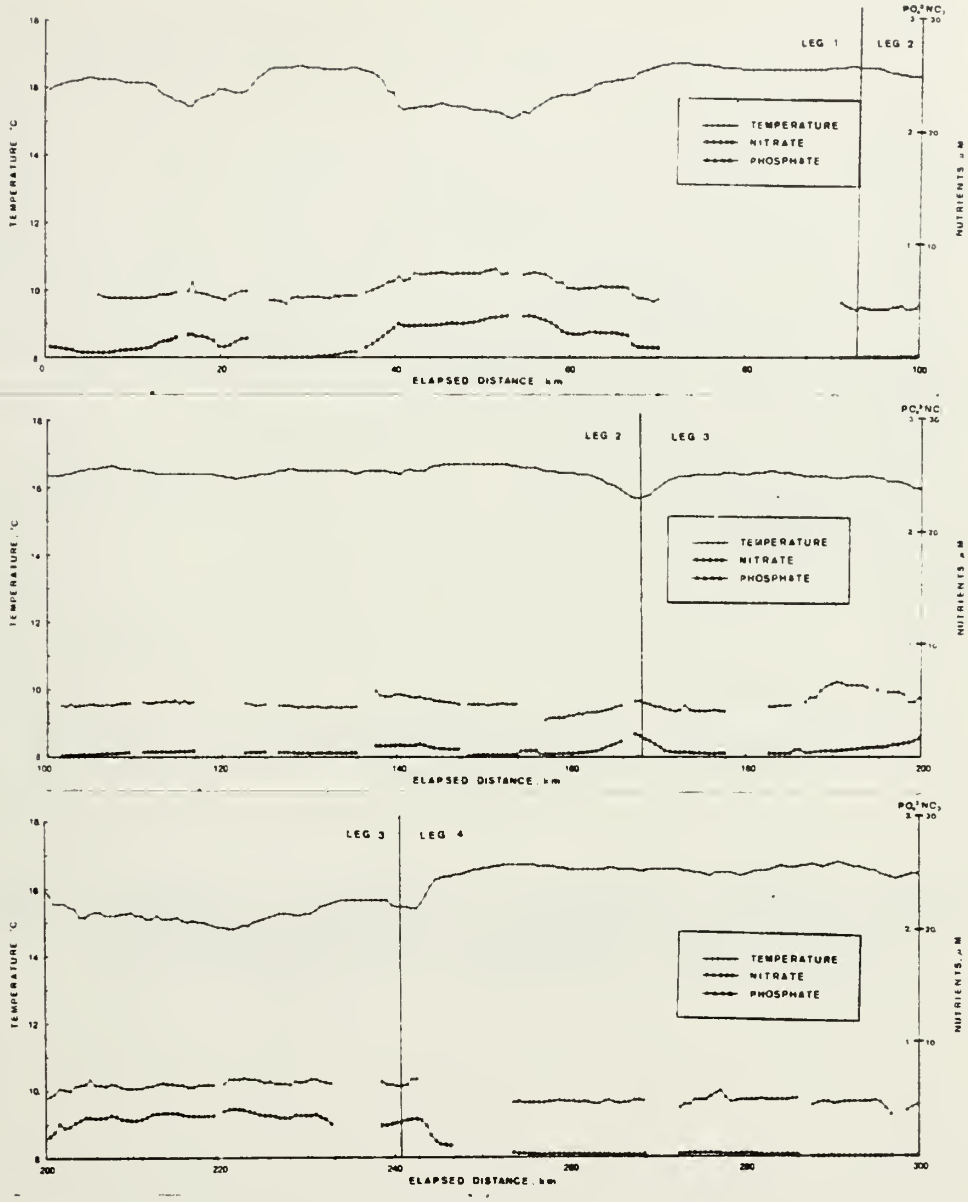


Fig. 4. Nitrate, phosphate, and sea surface temperature versus elapsed distance along the track of the September 1979 cruise.

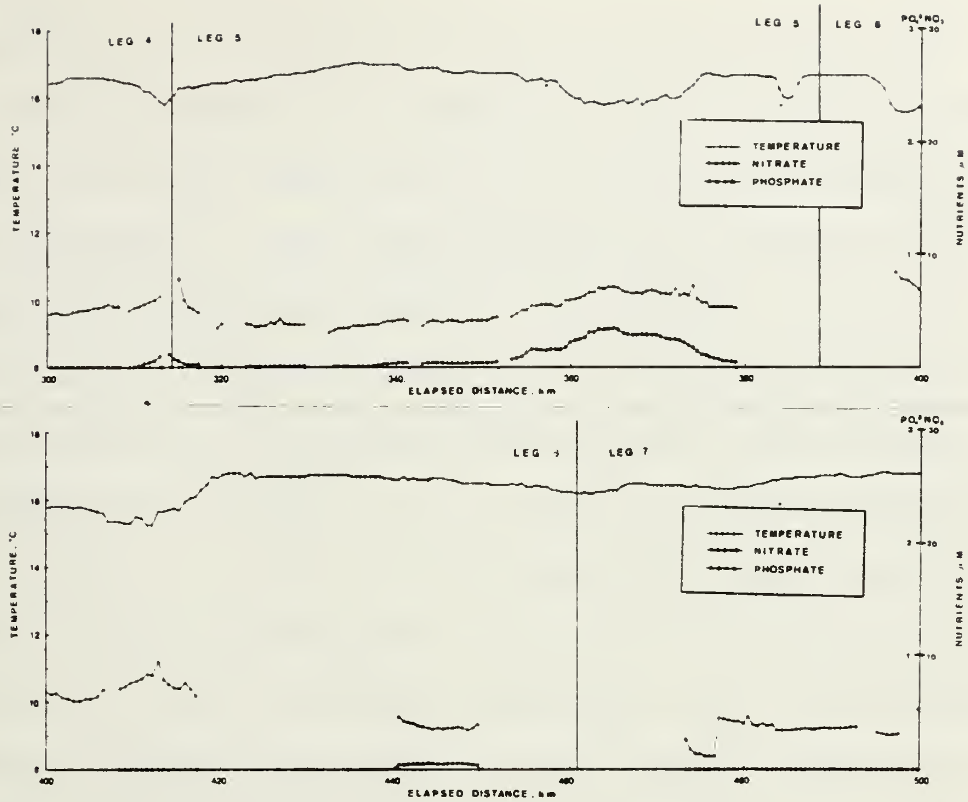


Fig. 4 (cont'd) Nitrate, phosphate, and sea surface temperature versus elapsed distance along the track of the September 1979 cruise.

to phosphate, r = -0.91 for nitrate to temperature, and r = -0.66 for phosphate to temperature were obtained (Table I). Nutrient ratio and temperature are plotted over elapsed distance in Figure 5. The linear correlation coefficient between nutrient ratio and temperature is r = -0.50.

The linear regression analysis of nitrate/phosphate, nitrate/temperature, phosphate/temperature, and nutrient ratio/temperature (Figs. 6, 7, 8, and 9) yielded slopes of 13.85, -2.66, -1.00, and -7.72 respectively, and x-axis intercepts of 0.45 μM phosphate, 16.68°C, 16.77°C, and 16.53°C respectively. The x-intercept indicated that the environment is nitrate limited and determined the warmest temperature for which these regression lines could be applied.

The major axis of the upwelling system appeared to parallel and be located in the vicinity of the Sur submarine canyon (Figs. 10, 11, 12, and 13). The largest area of the feature and the part which appears to curl cyclonically is south of the submarine canyon. The leading edge of the curl is located between the Sur and Lucia submarine canyons over the shelf slope, beyond the 1500 meter depth contour.

The incremental change per kilometer of temperature and nutrient concentrations are plotted over elapsed distance in Figure 14. The oceanic front appears to be located at elapsed distance 13, 18, 39, 67, 166, 200, 312, 361, and 414 km (Table II)

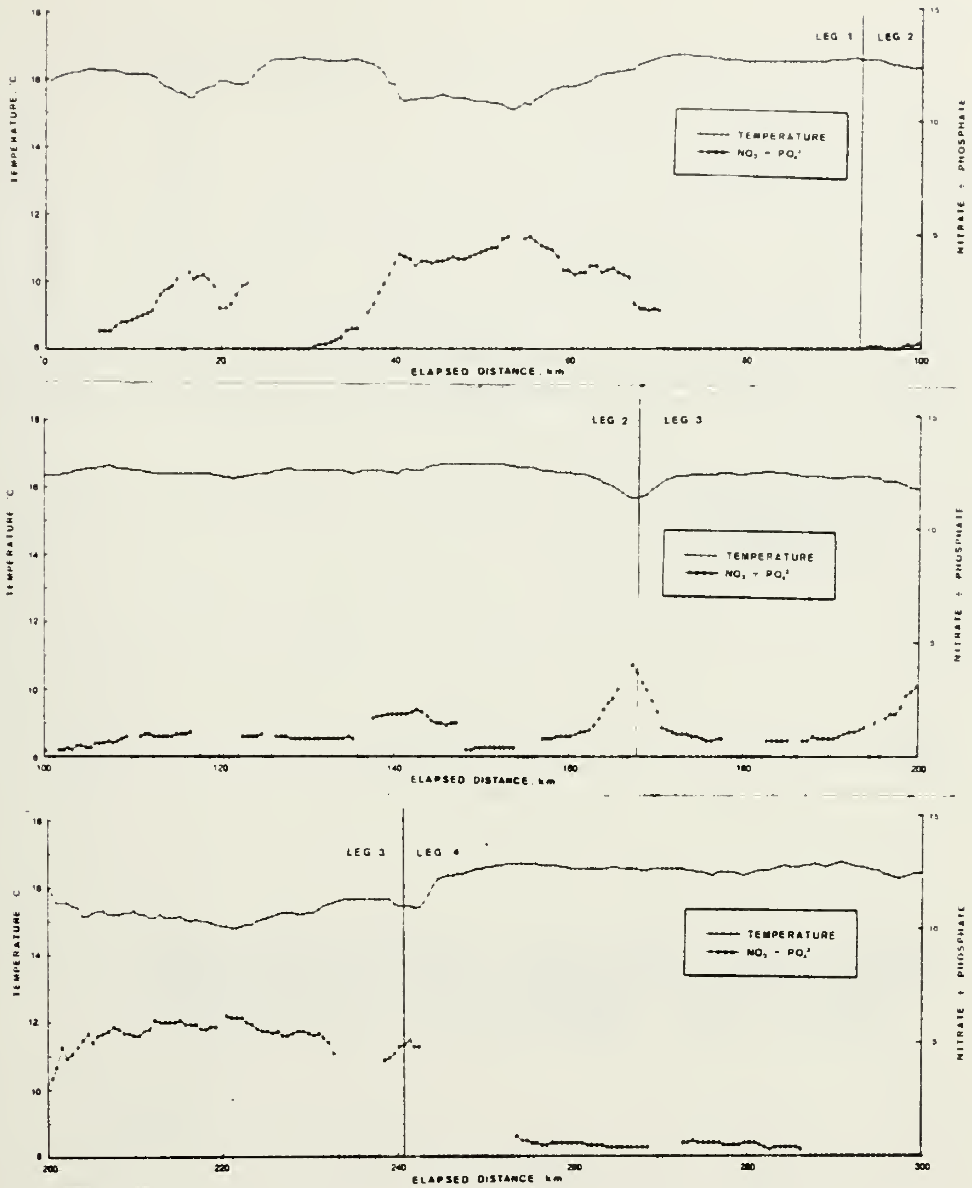


Fig. 5. Nutrient ratio and sea surface temperature versus elapsed distance along the track of the September 1979 cruise.

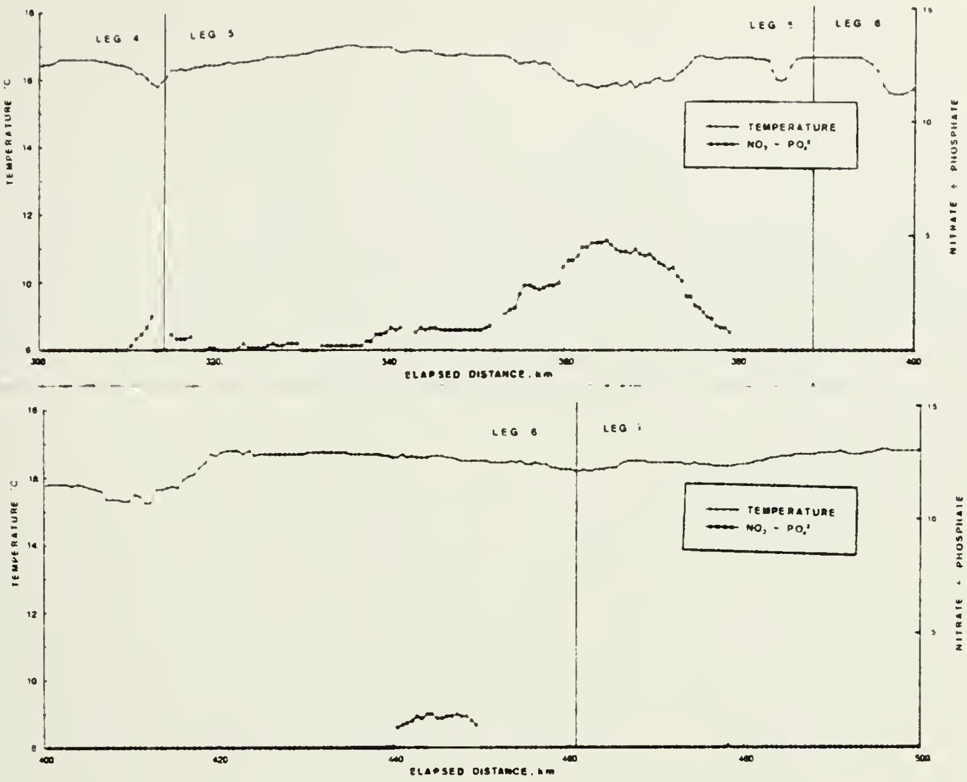


Fig. 5 (cont'd) Nutrient ratio and sea surface temperature versus elapsed distance along the track of the September 1979 cruise.

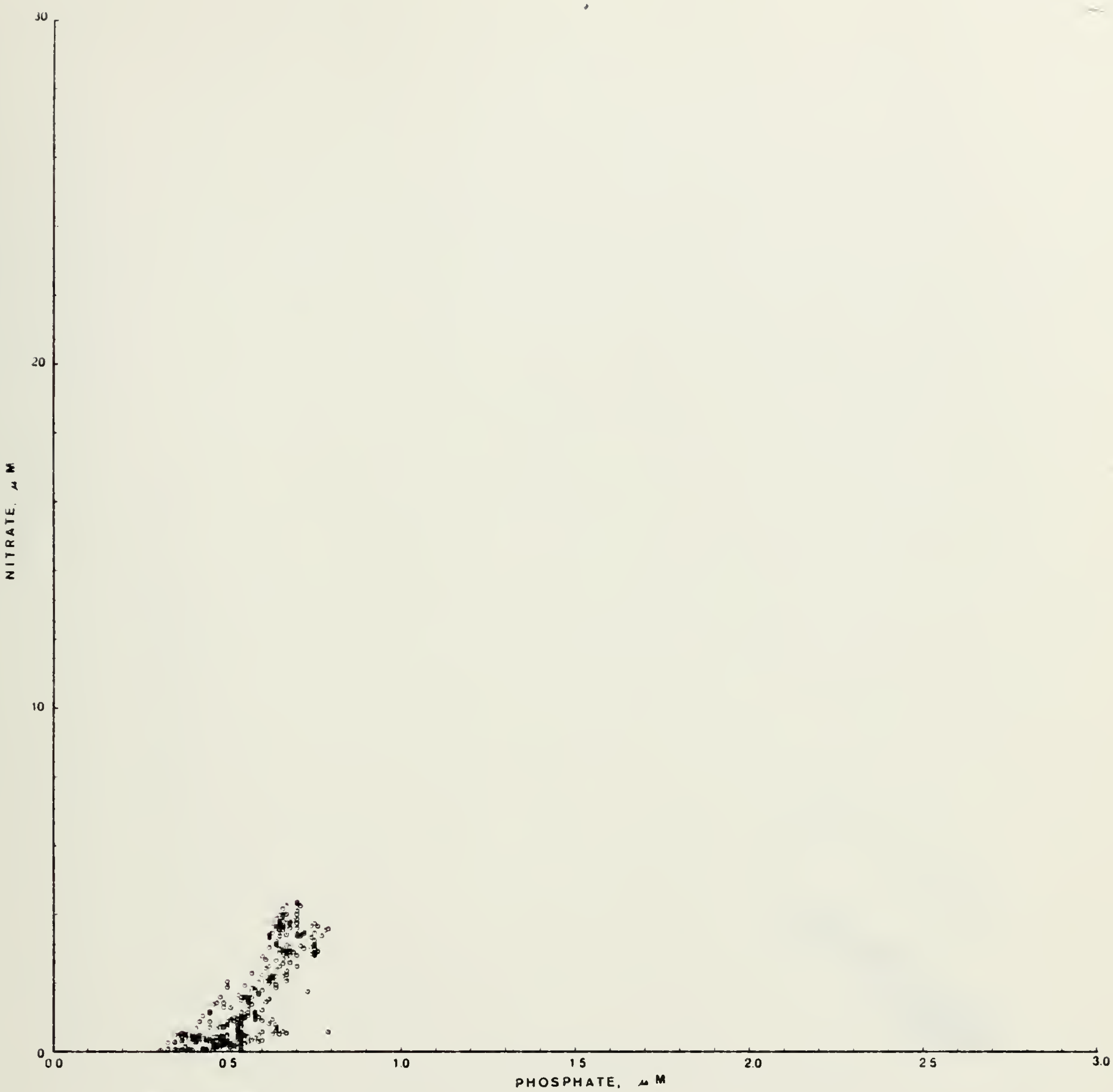


Fig. 6. Nitrate versus phosphate for the September 1979 cruise.

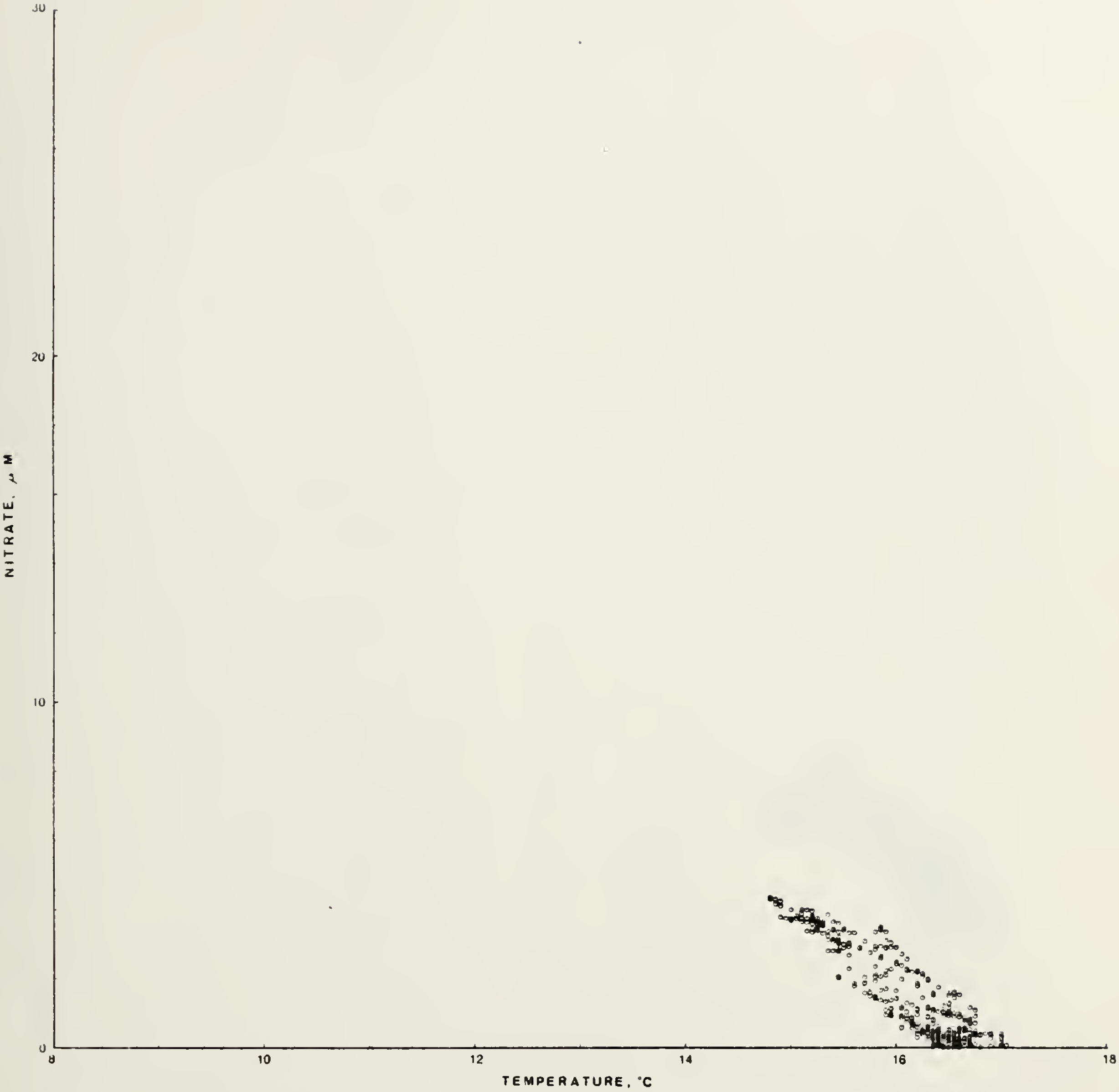


Fig. 7. Nitrate versus temperature for the September 1979 cruise.

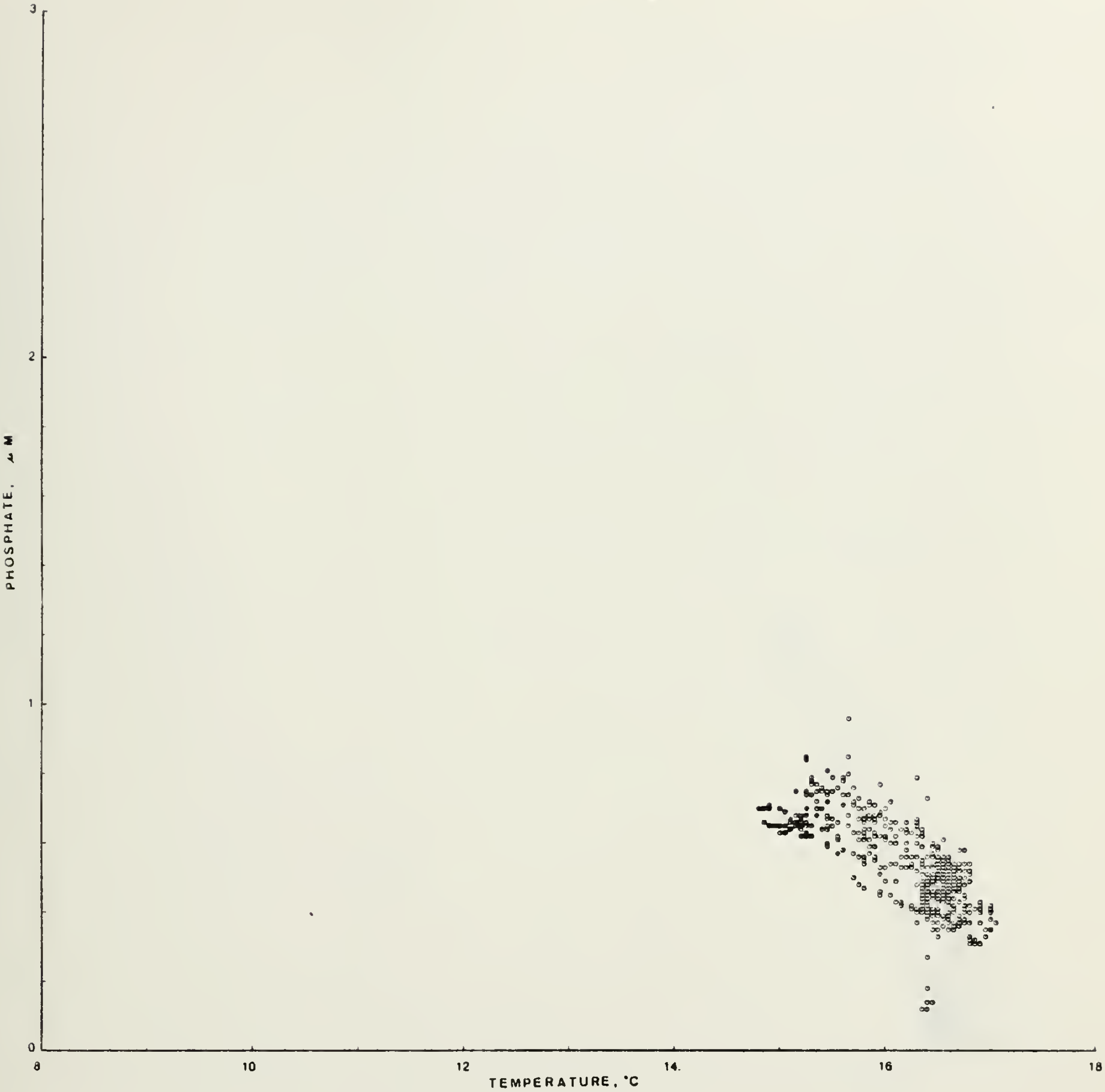


Fig. 8. Phosphate versus temperature for the September 1979 cruise.

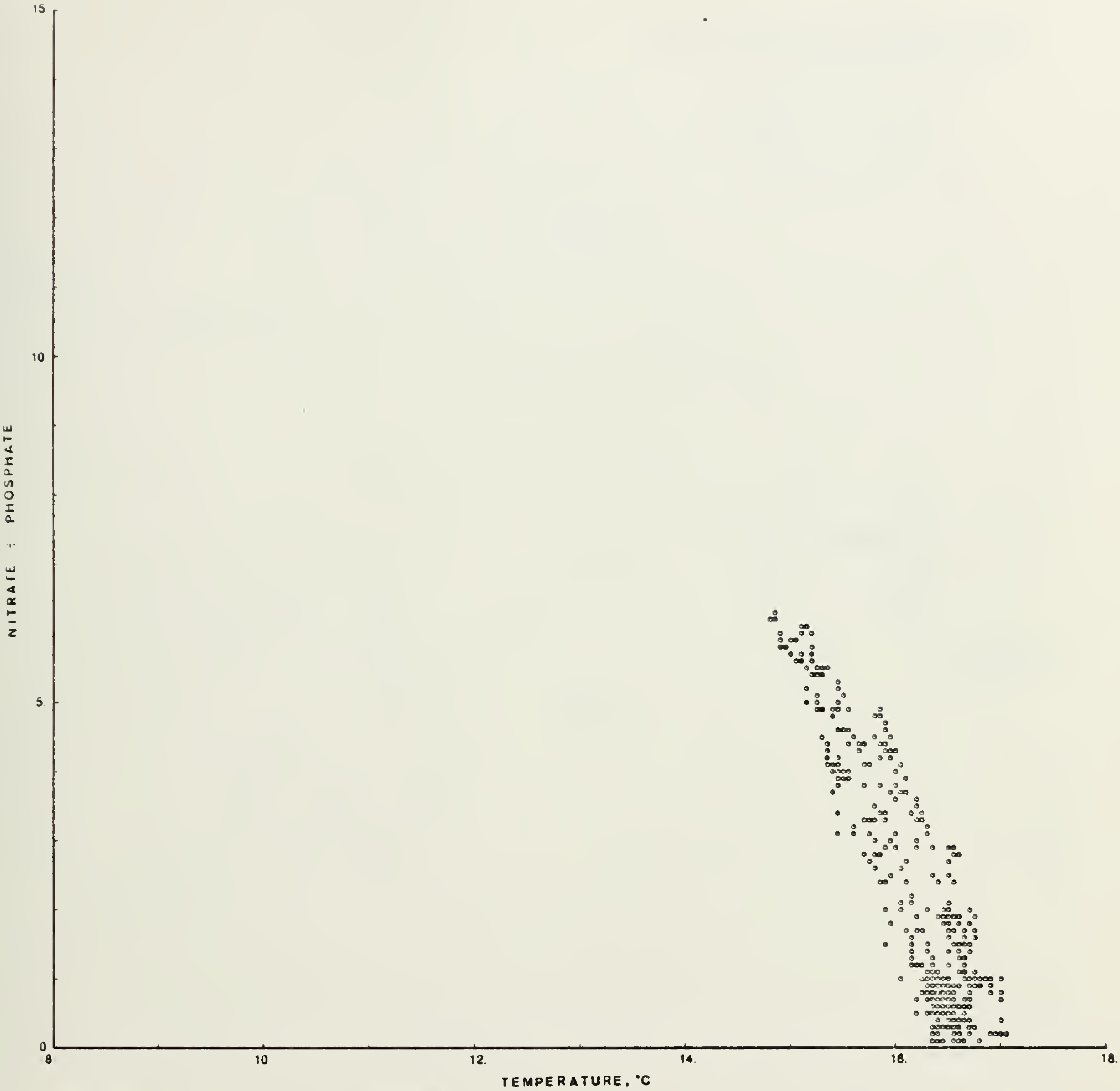


Fig. 9. Nutrient ratio versus temperature for the September 1979 cruise.

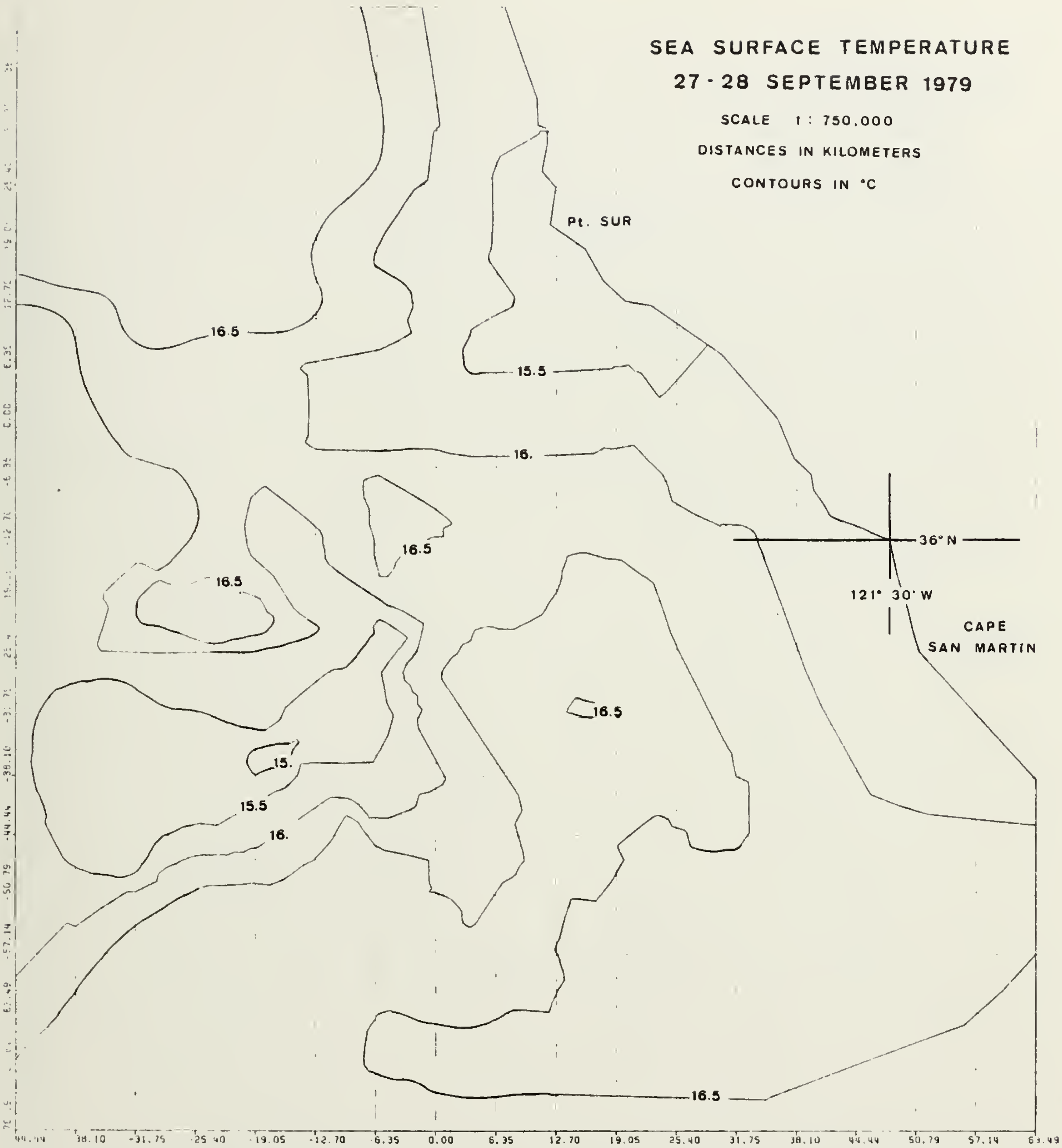


Fig. 10. Sea surface temperature map for the September 1979 cruise (contour interval, 0.5°C). Map generated from <u>in situ</u> data aided by IR imagery.

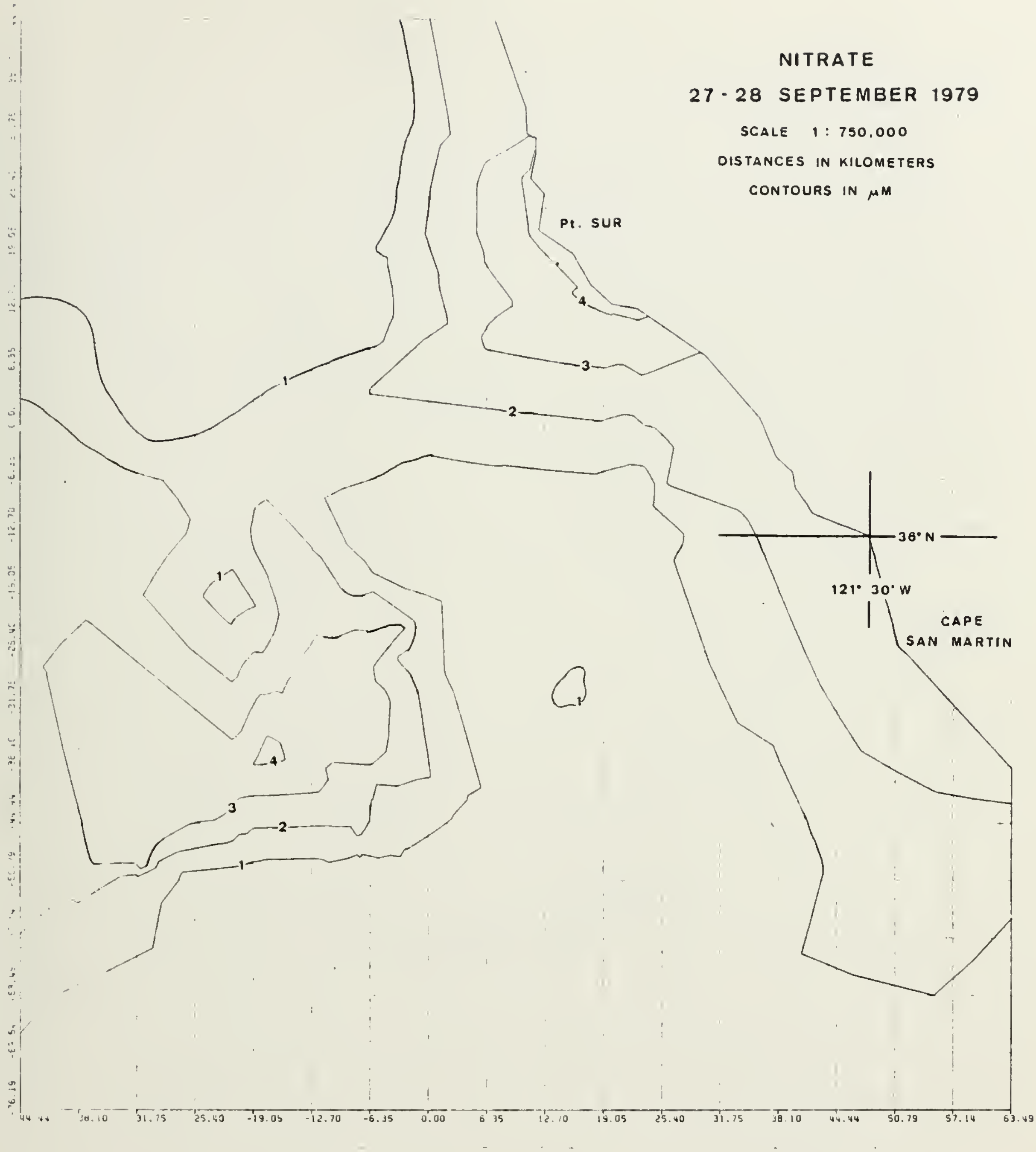


Fig. 11 Surface nitrate map for the September 1979 cruise (contour interval, 1 μM nitrate). Map generated from in situ data aided by inferences from IR imagery.

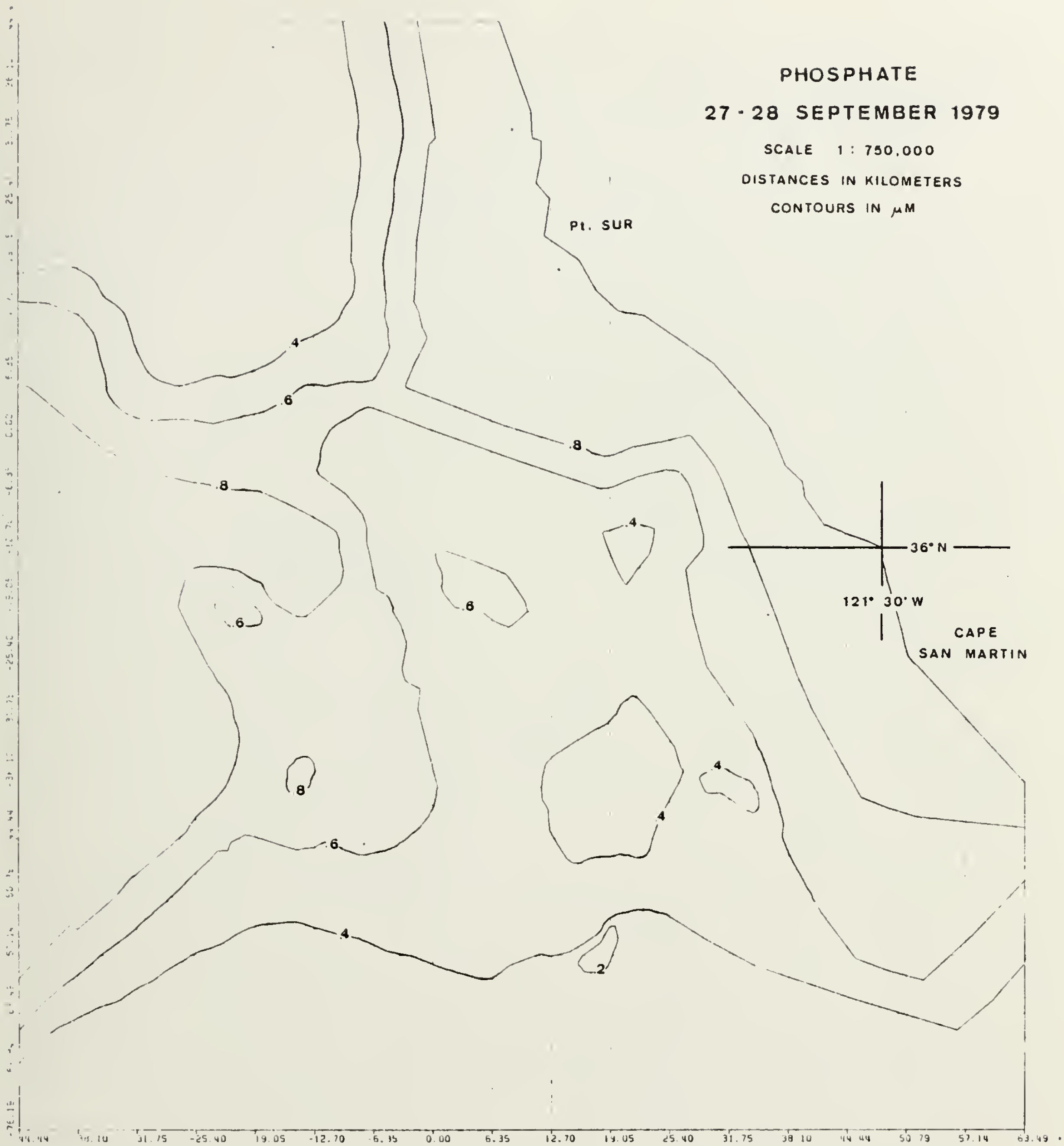


Fig. 12 Surface phosphate map for the September 1979 cruise (contour interval, 0.2 μM phosphate). Map generated by <u>in situ</u> data aided by inferences from IR imagery.

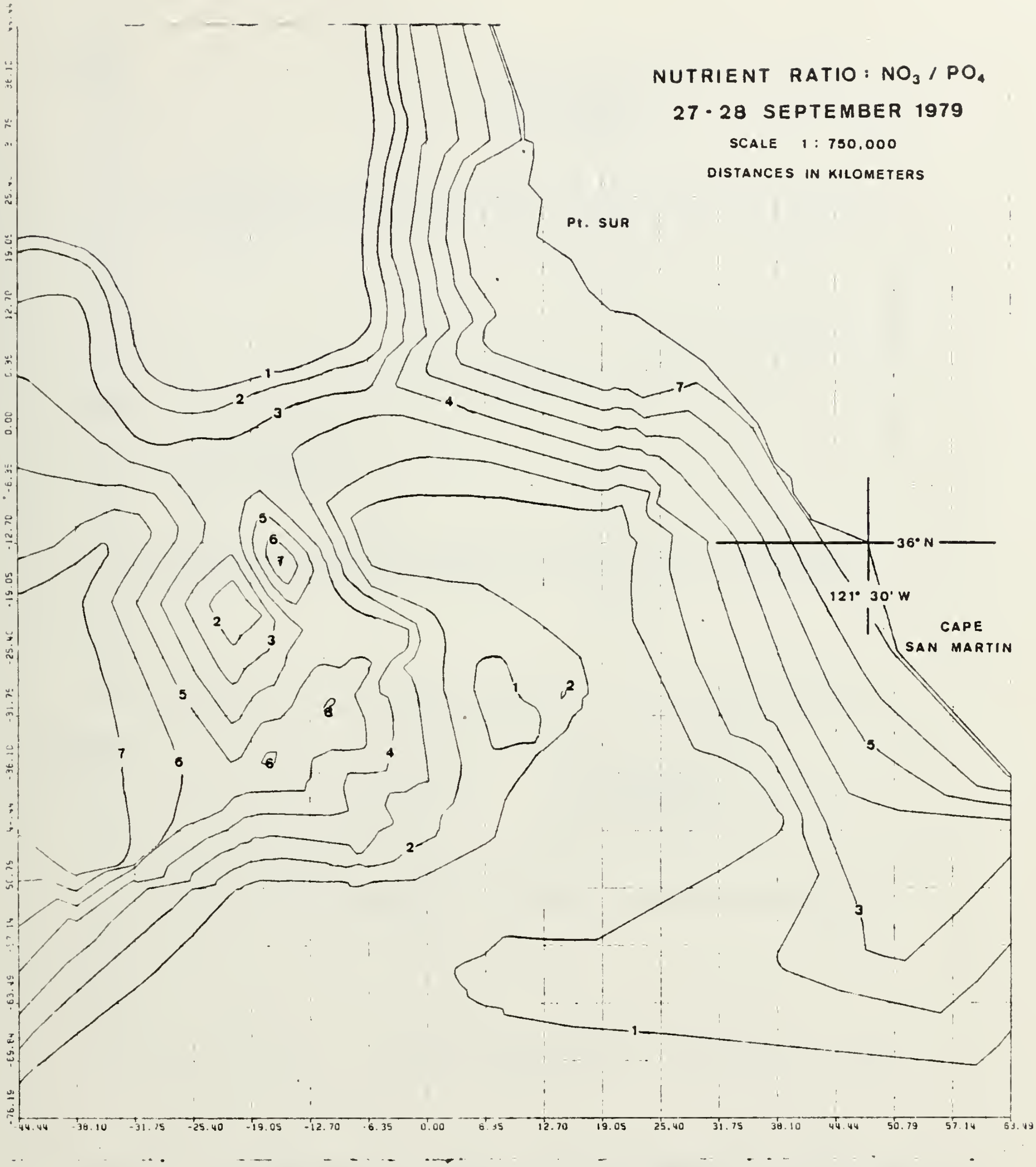


Fig. 13 Surface nutrient ratio map for the September 1979 cruise (contour ratio interval, 1). Map generated by <u>in situ</u> data aided by inferences from IR imagery.

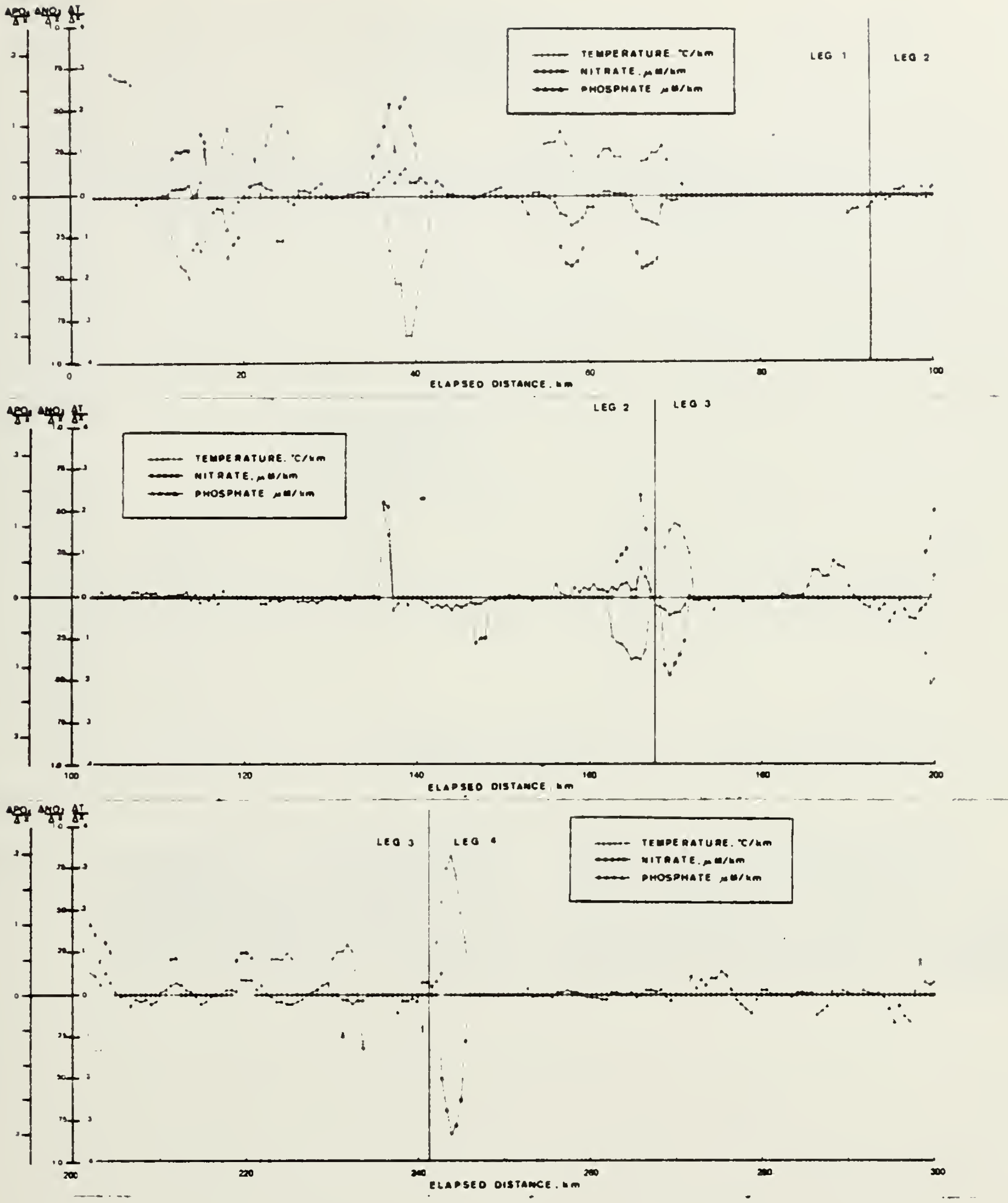


Fig. 14 Incremental change per kilometer of temperature, nitrate, and phosphate versus elapsed distance along the track of the September 1979 cruise. Frontal transit occurred at peaks.

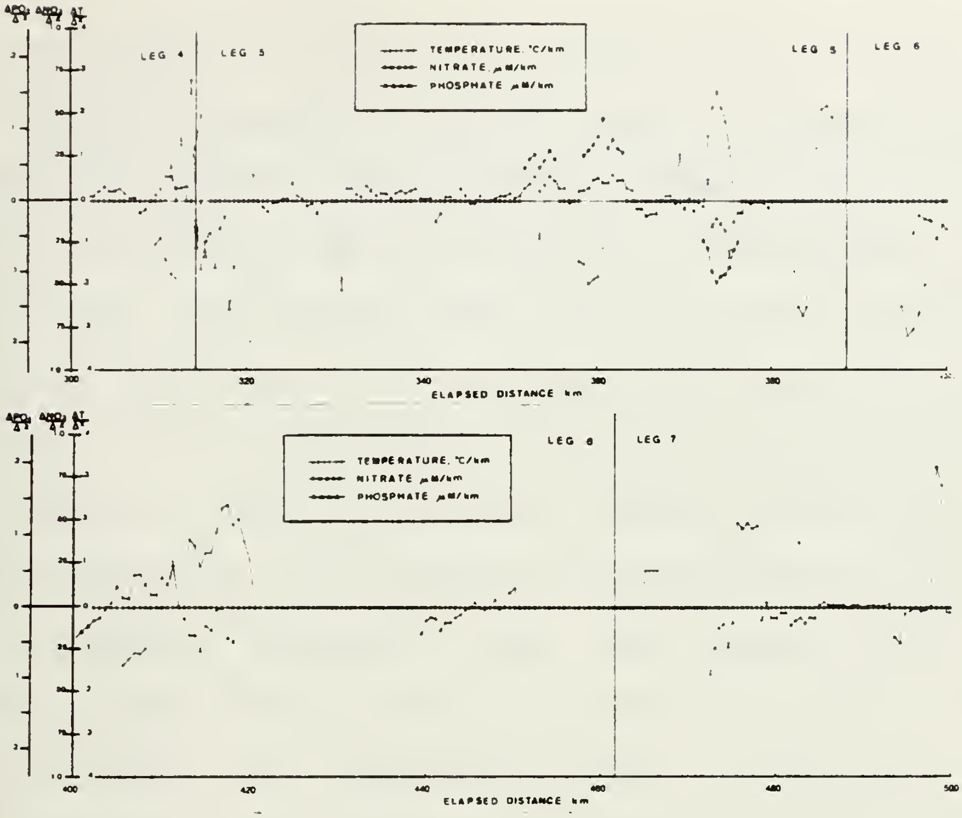


Fig. 14 (cont'd) Incremental change per kilometer of temperature, nitrate, and phosphate versus elapsed distance along the track of the September 1979 cruise. Frontal transit occurred at peaks.

The thermal and chemical gradients are both sharp and well defined despite a narrow spread of surface nutrient and temperature values between the ocean and the upwelling system, 0.01 to 4.36 μM nitrate, 0.03 to 0.96 μM phosphate, and 17.05 to 14.80°C. The oceanic front seemed to stay in close proximity to the 15.9°C, 1.7 μM nitrate, and 0.6 μM phosphate isolines. The oceanic front is outlined in Figure 3.

Figure 15 shows the vertical thermal structure of the upwelling system. One hundred forty XBT probes were used with an average spacing of 4 km. The thermal feature is evident from 15 to 26, 43 to 64, 197 to 246, 372 to 383, and 408 to 428 km. The thermocline under the upwelling system was continuous but upwarped to within 20m of the surface.

B. NOVEMBER 1979 CRUISE

The staff oceanographer at NESS began monitoring satellite images of the study area on 9 November. He noticed a discernible though weak thermal feature on 11 November. It extended 35 km southwest of Pt. Sur. From satellite observation, the thermal feature appeared to reach its maximum seaward extent of at least 60 km on 20 November. By 27 November it had become diffuse and by 28 November was indistinguishable. Due to intermittent cloud cover, no satellite information pertaining to a specific feature was therefore available when the ship departed 28 November. A prior cruise in the area from 26 to 27 November detected a frontal feature from in situ temperature measurements.

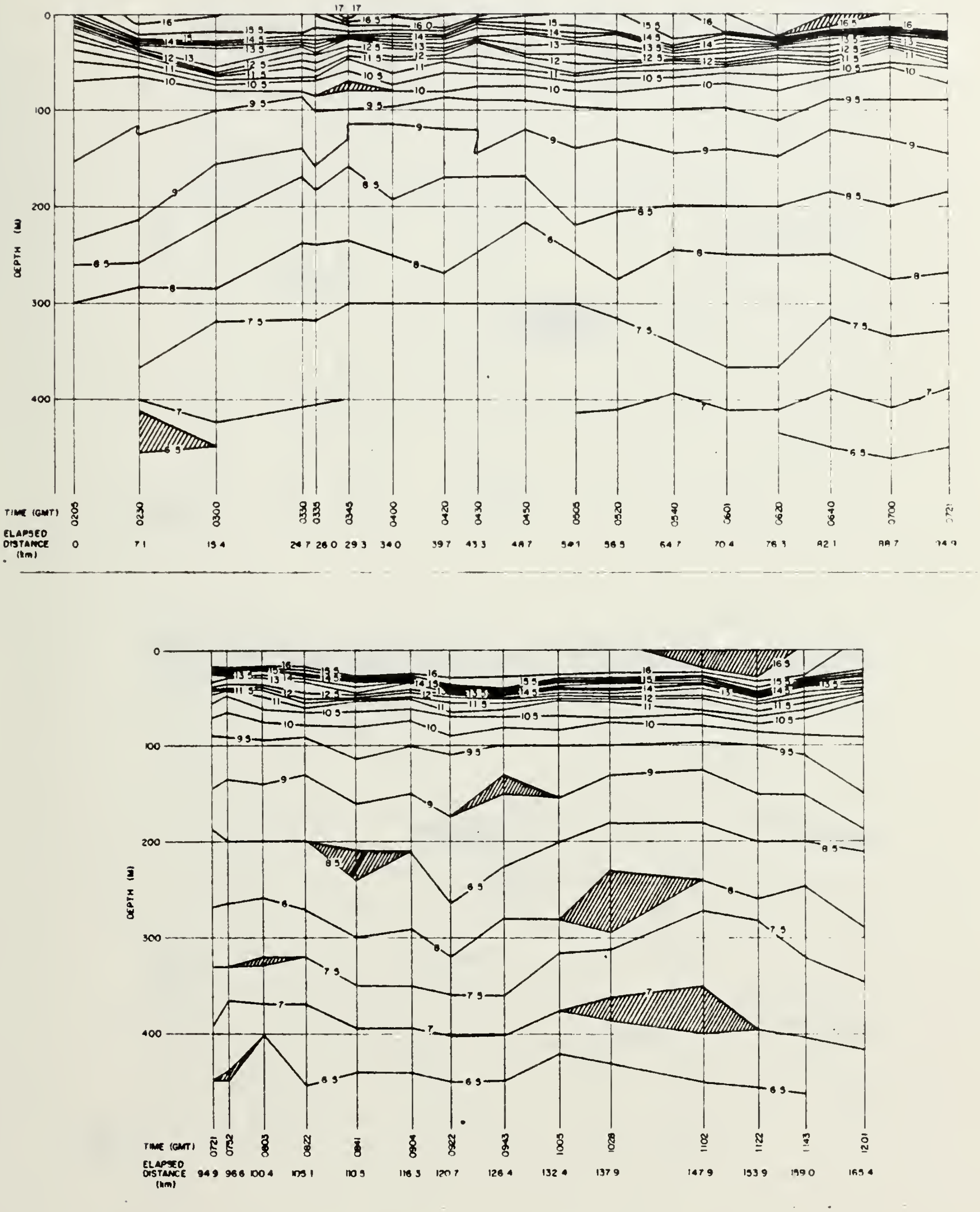


Fig. 15 Vertical temperature sections along the track of the September 1979 cruise [Johnson, 1980]. Vertical lines represent XBT drops.

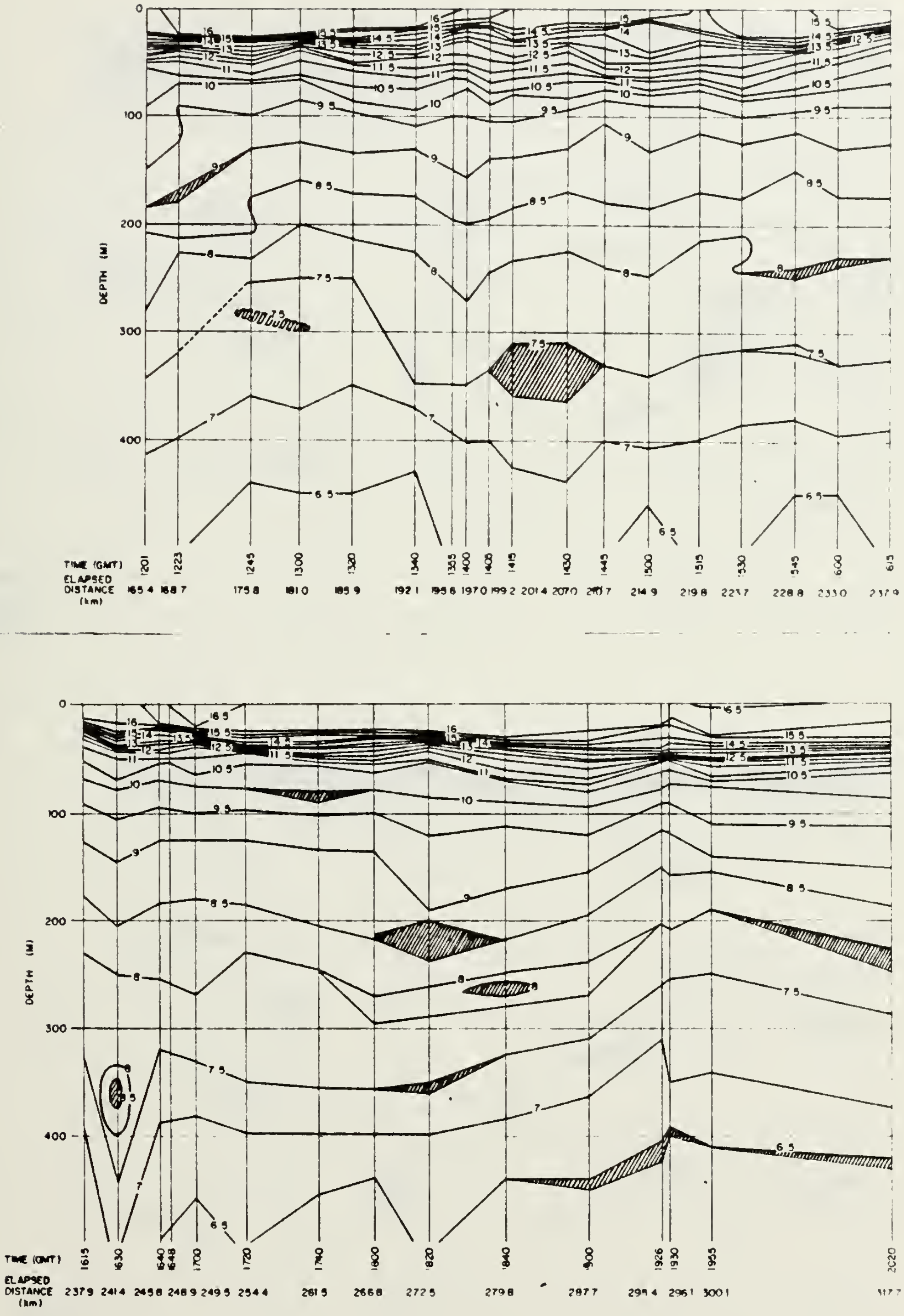


Fig. 15 (cont'd) Vertical temperature sections along the track of the September 1979 cruise [Johnson, 1980]. Vertical lines represent XBT drops.

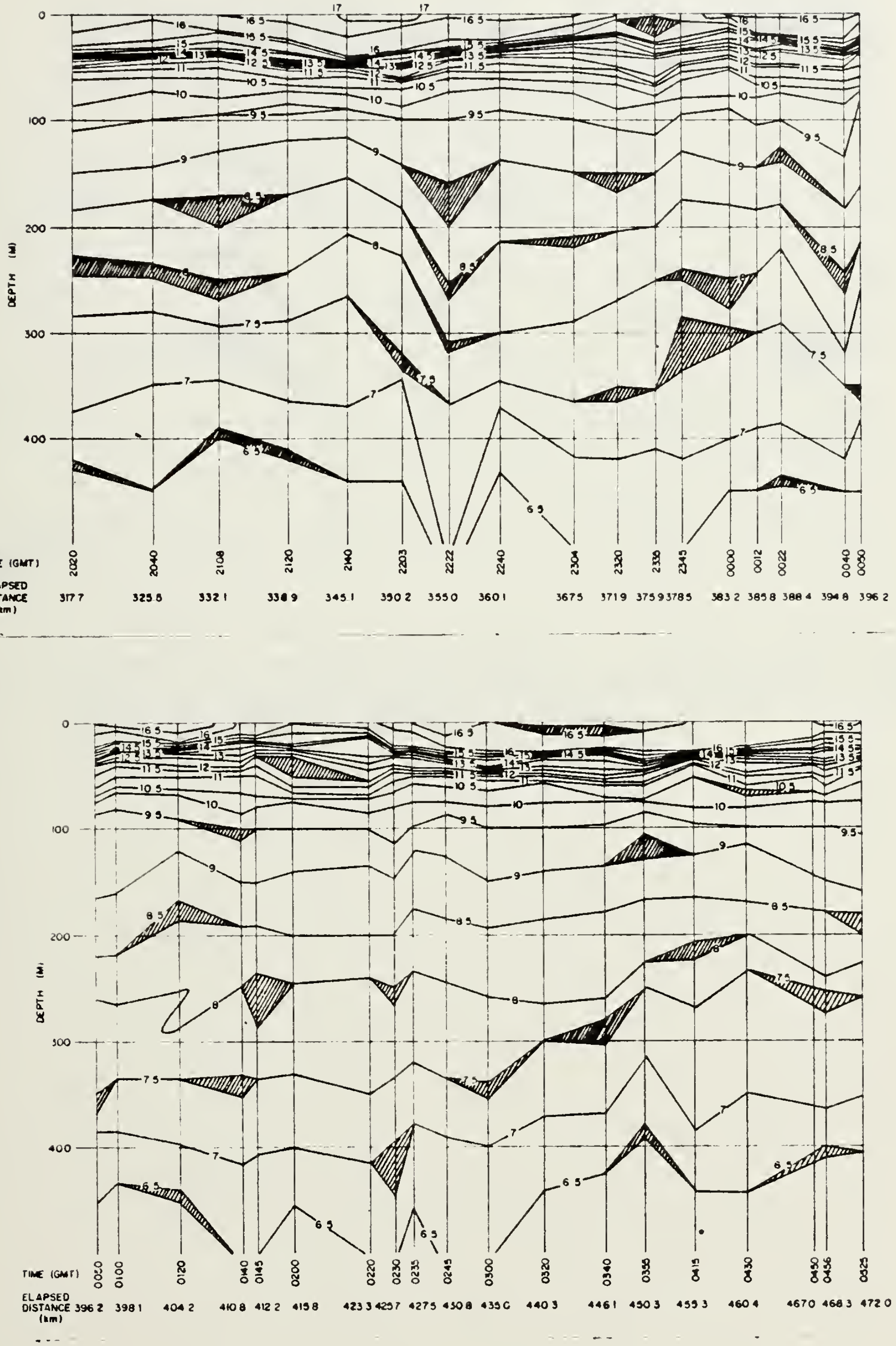


Fig. 15 (cont'd) Vertical temperature sections along the track of the September 1979 cruise [Johnson, 1980]. Vertical lines represent XBT drops.

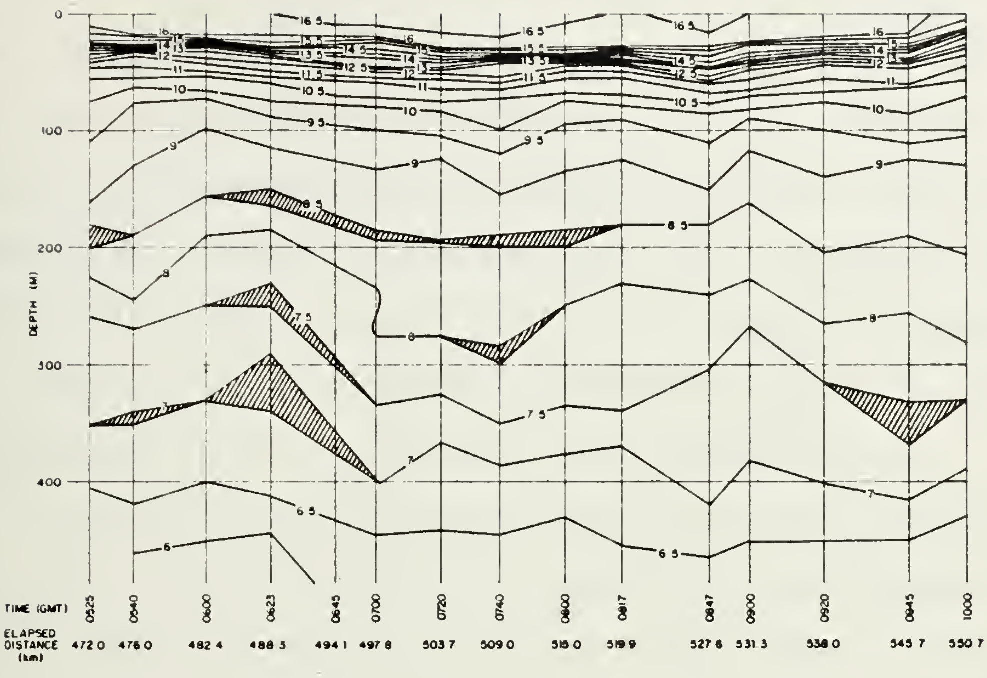


Fig. 15 (cont'd) Vertical temperature sections along the track of the September 1979 cruise [Johnson, 1980]. Vertical lines represent XBT drops.

As it happened, another distinctive thermal pattern was seen later in images on 28 November. This feature extended west of Pt. Sur and grew to maximum size by 6 December. It advected north and apparently merged with upwelling off Monterey Bay around 14 December (Fig. 16). Despite intermittent cloud cover, the best satellite image was taken during the study period at 2310 GMT, 29 November (Plate 2). The average wind was 3 to 5 $m \cdot sec^{-1}$ from the northwest.

The cruise plan had the ship transit south paralleling the coast. When the front was penetrated, an expanding square search would be followed to delineate the shape, center, orientation, and size of the feature. A ladder search pattern was then to be executed to provide additional transits across the major axis of the feature. When the expanding square search located a small feature south of Pt. Sur, the ship transited north along a front and then began a ladder search seaward. The first leg transected the major axis of a large feature located west of Pt. Sur. After the general location of a sharp thermal gradient was found about the feature, an expanding square search was begun in the vicinity of the leading edge (Fig. 17).

The data herein presented is associated with those measurements taken during this ladder search and final expanding square. In addition, seven oceanographic stations were occupied near the end of the study period. Nansen casts were made to sample temperature, salinity, and nitrate.

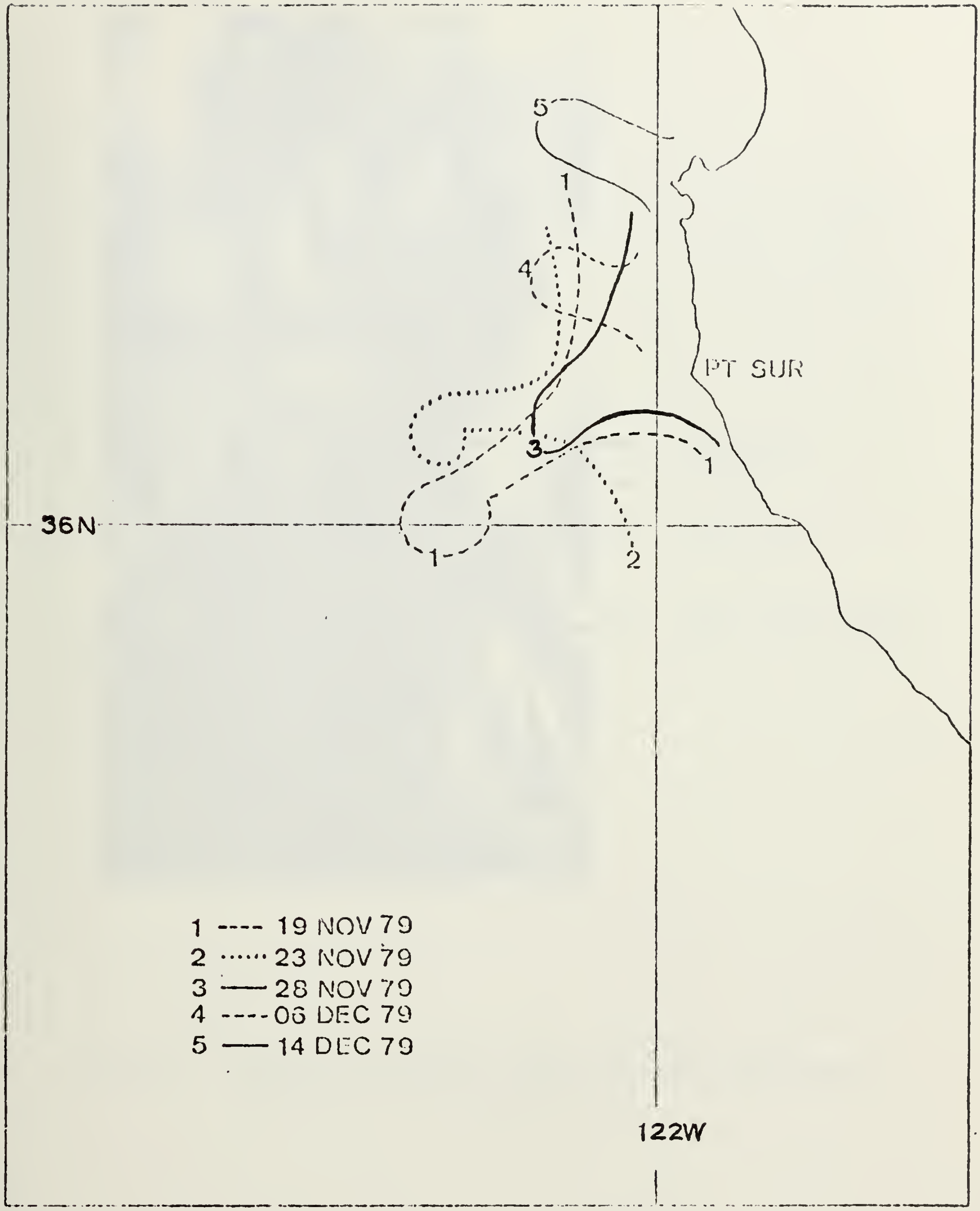


Fig. 16 Satellite feature observed from 19 November to 14 December 1979 [Johnson, 1980].

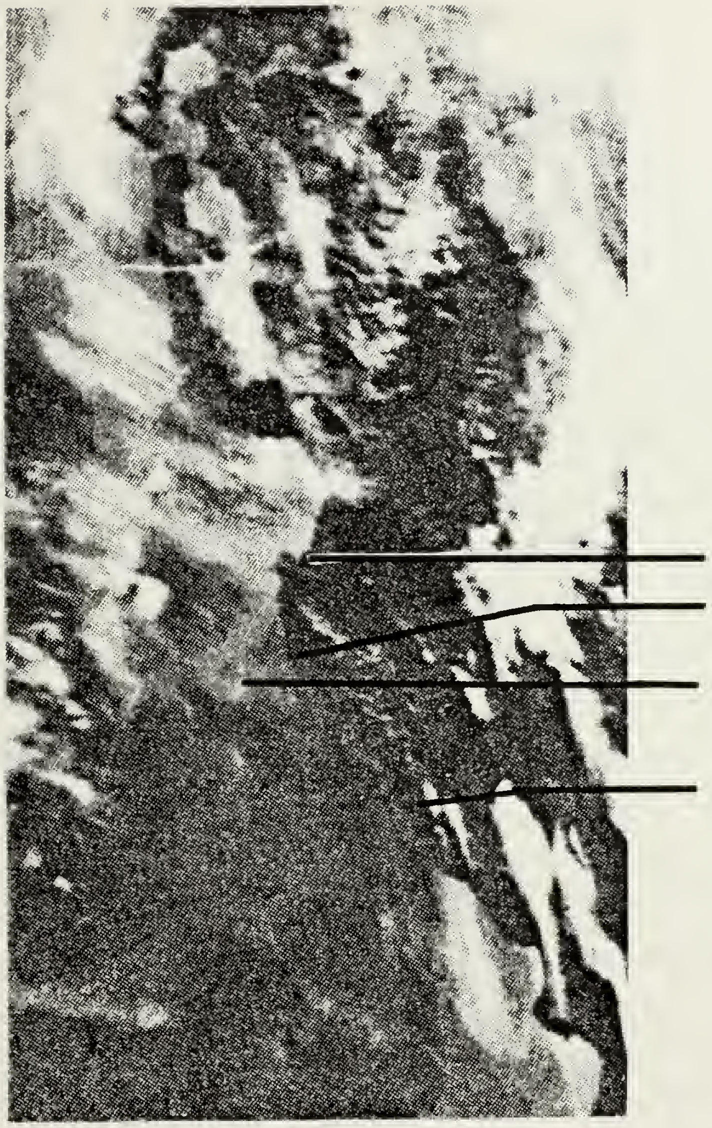
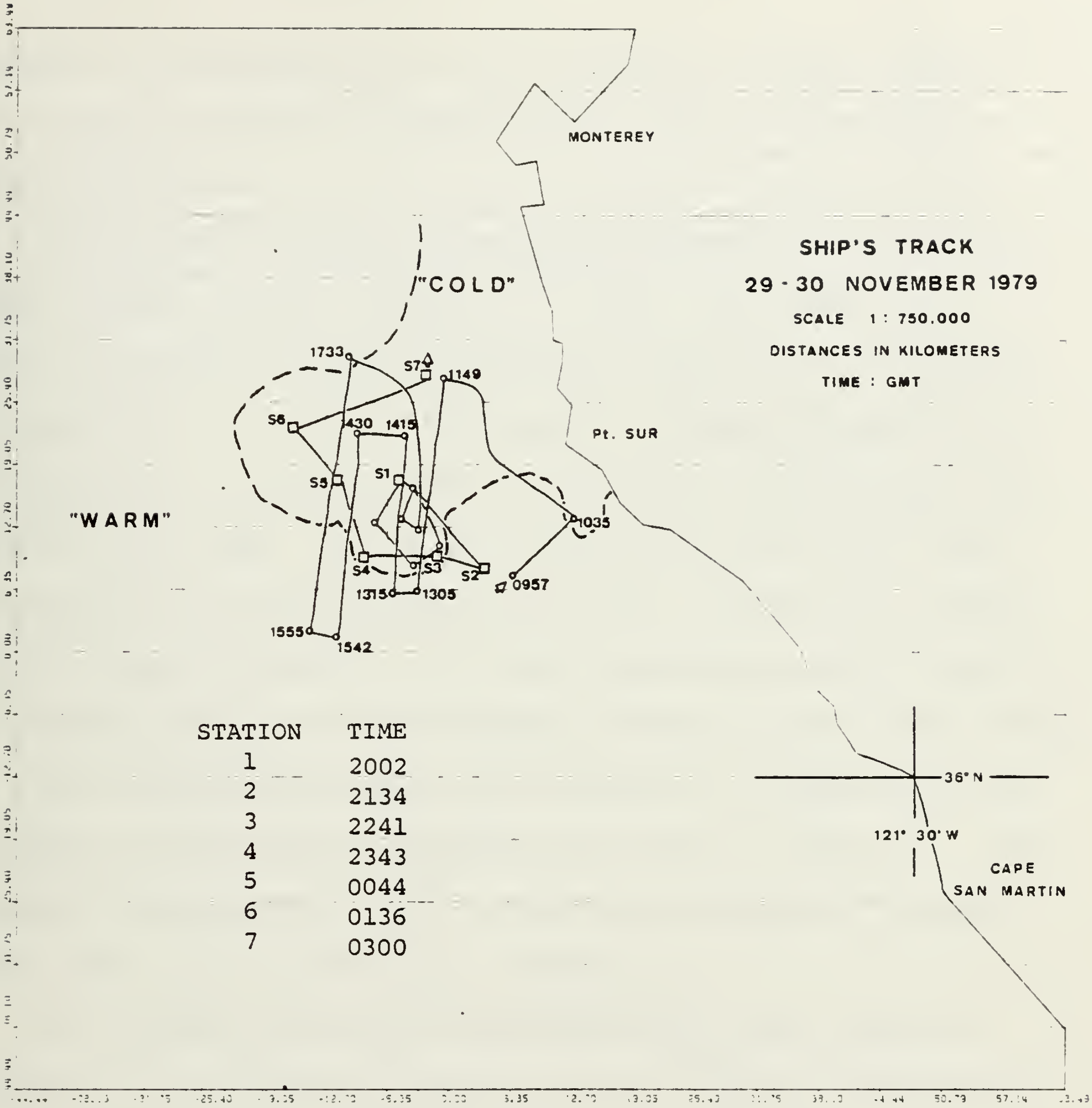


Plate 2. TIROS-N satellite image of the California coast for 29 November 1979.



STATION	TIME
1	2002
2	2134
3	2241
4	2343
5	0044
6	0136
7	0300

Fig. 17 Track of the November 1979 cruise and outline (dashed line) of the oceanic front.

Because of contamination in the combined working reagent, no reliable phosphate concentrations could be measured on the Autoanalyzer.

The inverse correlation between nitrate and temperature (Fig. 18 and 19) was strong, r = -0.93. The regression line of nitrate to temperature had a slope of -3.24 and an x-intercept of 14.74°C. The feature extended seaward in a southwesterly direction from a point near the coast ca. 20 km north of Pt. Sur. At a position ca. 20 km west of Pt. Sur, it appeared to curl cyclonically (Figs. 20 and 21). Unlike the September feature, this upwelling system did not appear to extend beyond the shelf slope to depths greater than 1200m.

The incremental change per kilometer of temperature and nitrate are plotted over elapsed distance in Figure 22. The oceanic front appears to be transited at elapsed distances 151, 196, 203, 231, 257, and 270 km.

The thermal and nitrate gradients are sharp and well defined. The steepest appear to occur near the equatorward edge of the curl. Compared with the September cruise, the nitrate gradient at the front is greater for the December feature, whereas the temperature gradients show no great variation (Table II). The spread of the surface temperature and nitrate values between the ocean and the upwelling feature, 15.50 to 11.85°C and 0.12 to 9.92 μM nitrate, was greater in magnitude than the September cruise. The oceanic

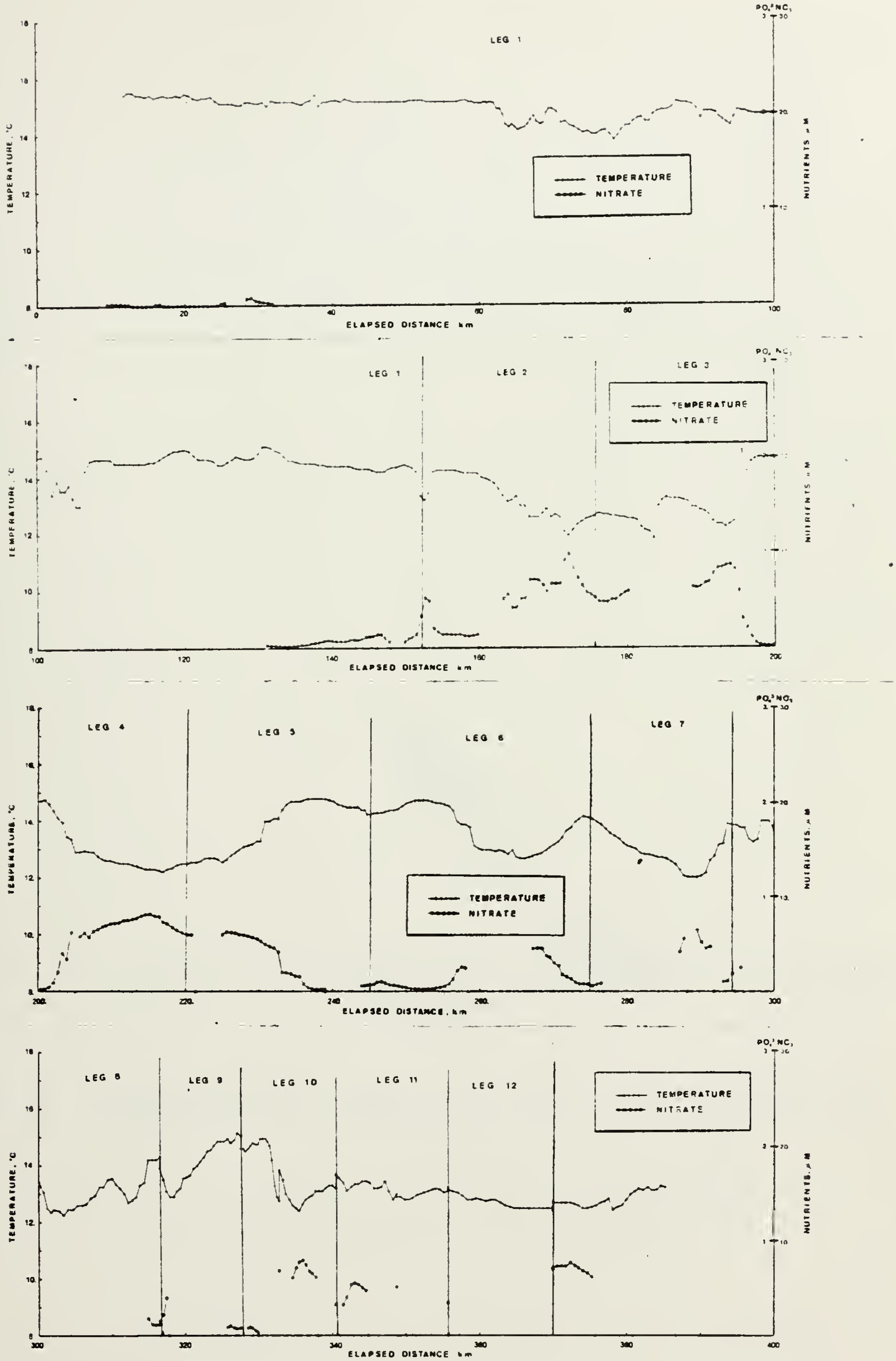


Fig. 18 Nitrate and sea surface temperature versus elapsed distance along the track of the November 1979 cruise.

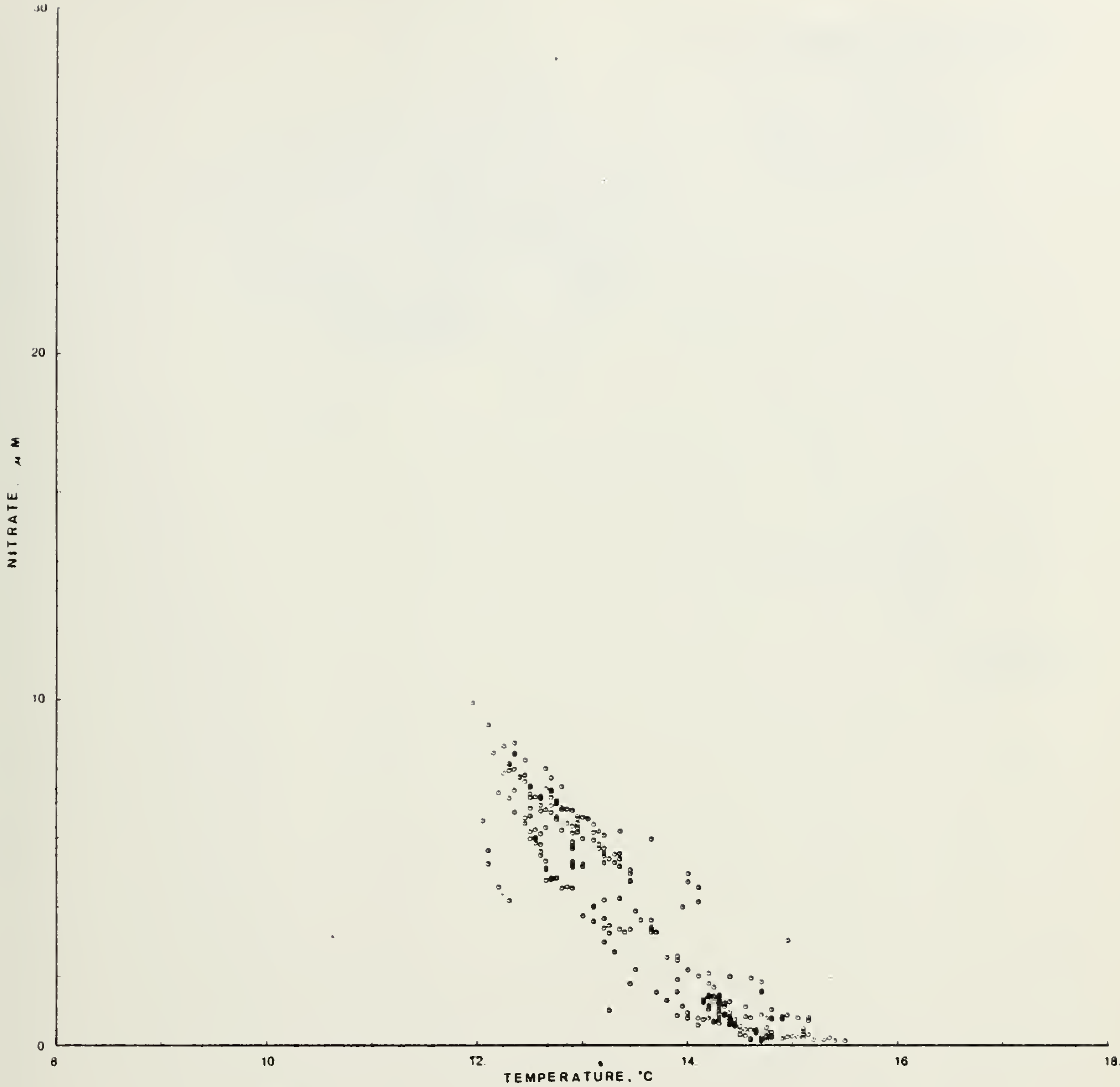


Fig. 19 Nitrate versus temperature for the November 1979 cruise.

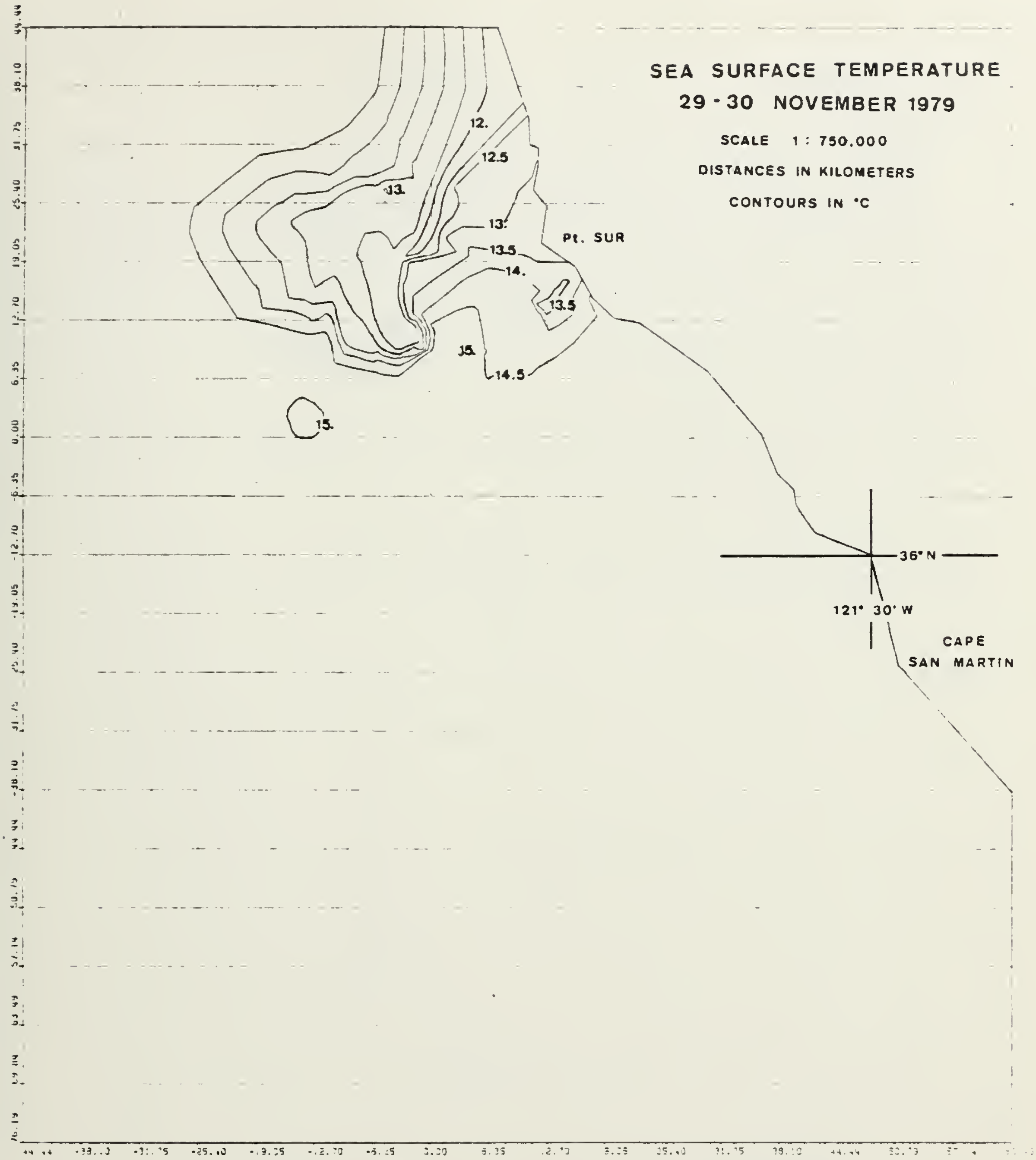


Fig. 20 Sea surface temperature map for the November 1979 cruise (contour interval 0.5°C). Map generated from <u>in situ</u> data aided by IR imagery.

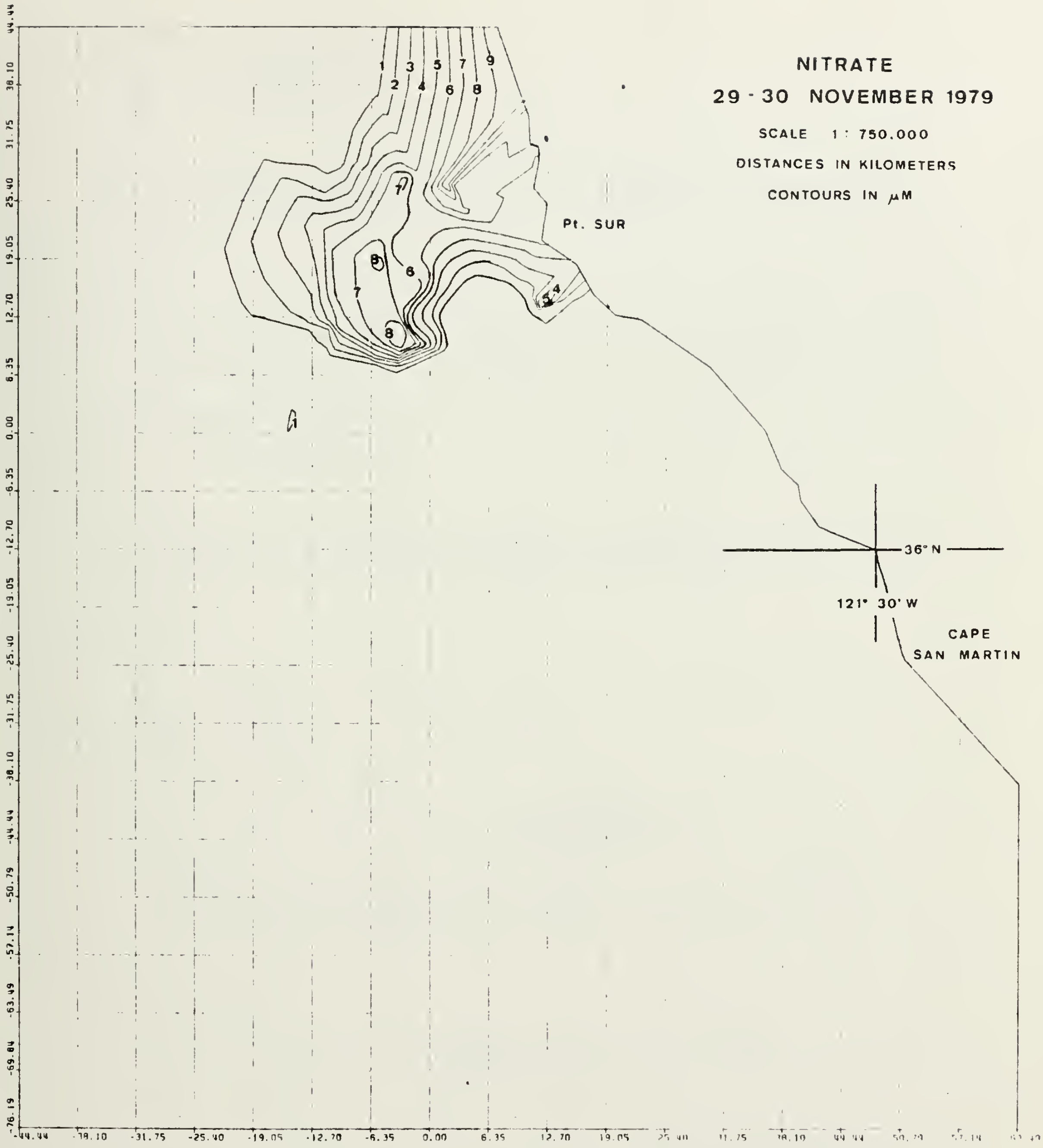


Fig. 21 Surface nitrate map for the November 1979 cruise (contour interval, 1 μM nitrate). Map generated from in situ data aided by inferences from IR imagery.

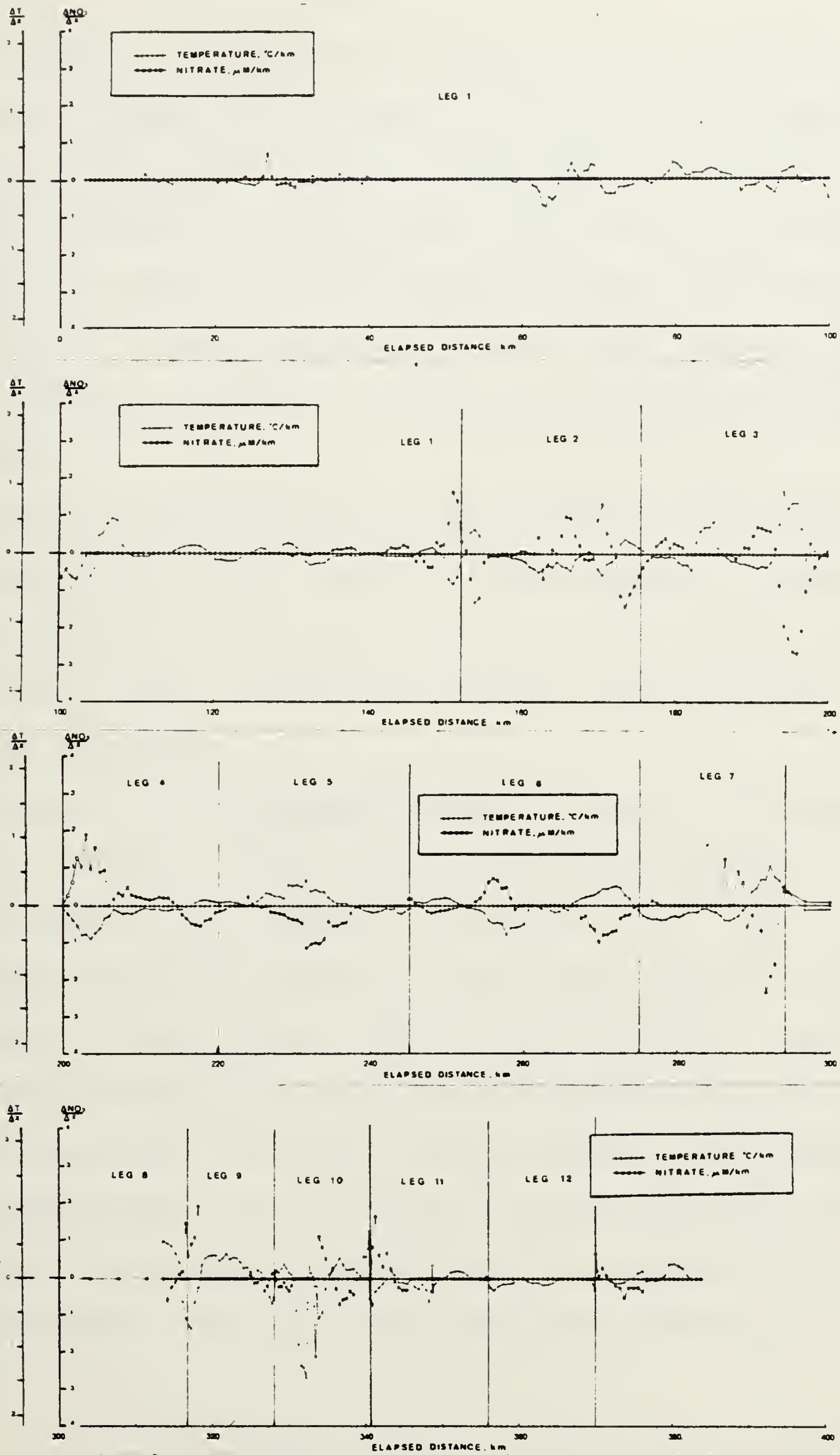


Fig. 22 Incremental change per kilometer of temperature and nitrate versus elapsed distance along the track of the November 1979 cruise. Frontal transit occurred at peaks.

front seemed to closely approximate the 14.0°C and 2.5 μM nitrate isolines. The oceanic front is noted in Figure 17.

Figure 23 shows the vertical profile of the upwelled feature based on 40 XBT profiles. The vertical thermal structure is apparent from elapsed distance 179 to 216, 226 to 247, 275 to 290, and 298 to 319 km. The thermocline under the upwelling system is continuous and shows no great perturbations.

The data obtained from the seven Nansen casts appears in Figures 24 and 25. Because of the increase in nitrite as depth increases, the actual concentration of nitrate below the surface layer can be less than the values recorded (see Methods: Nutrients).

Station 7 was taken near the major axis of the upwelling system, whereas station 2 sampled the warmer oceanic water to the south of the feature. Stations 3, 4, 5, and 6 were all taken in close proximity to the oceanic front. An intrusion of warmer oceanic water into the central region of the feature appeared to have been recorded at station 1. The Nansen cast data showed that the upwelling system apparently corresponded to a 26.4 σ_t tongue of water upwarping close to the coast and travelled seaward near the surface. The nitrate concentrations seem to closely agree with the density structure.

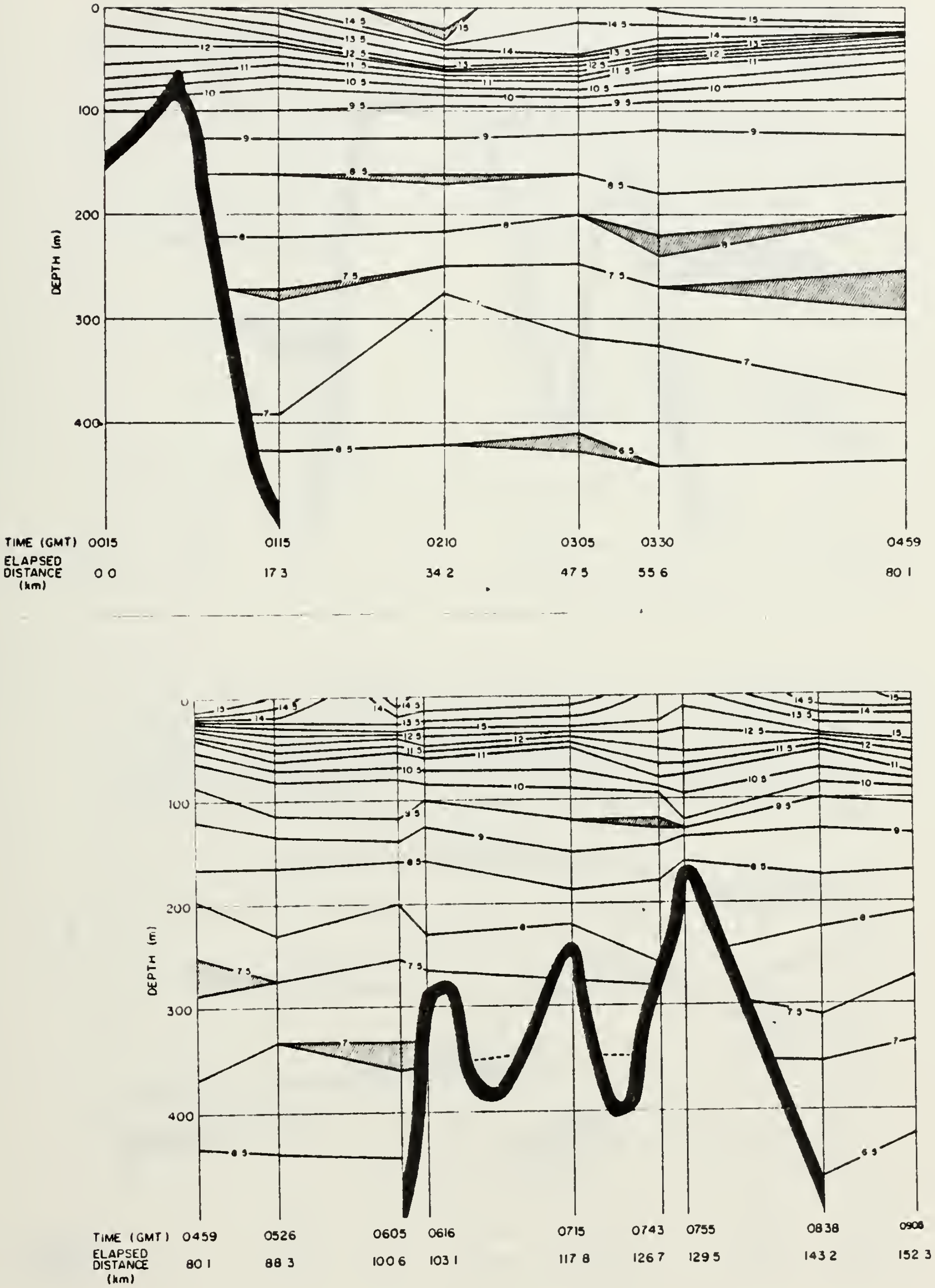
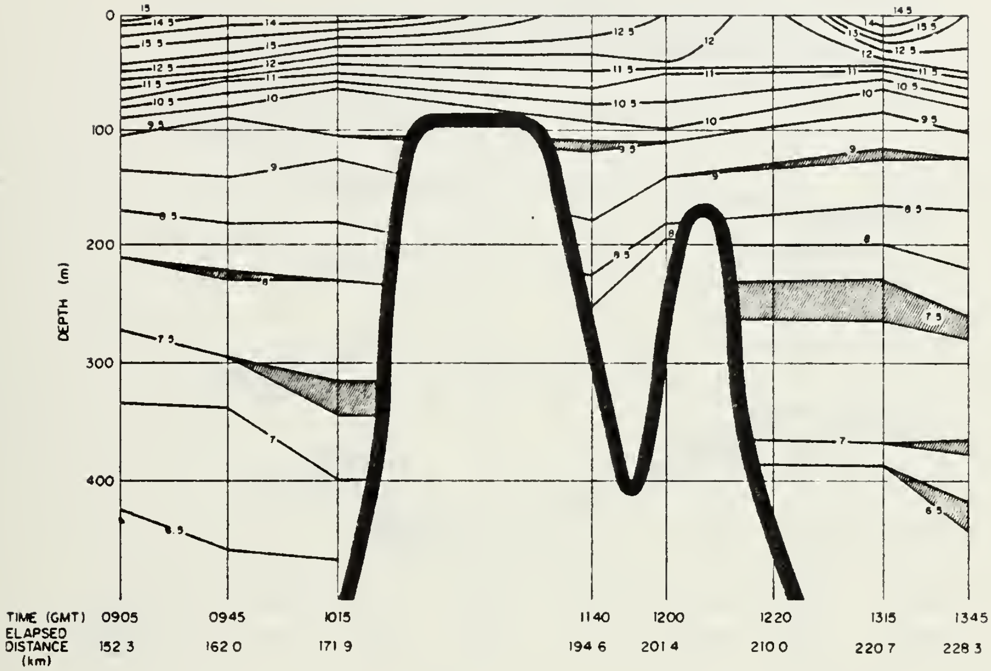


Fig. 23 Vertical temperature sections along the track of the November 1979 cruise [Johnson, 1980]. Vertical lines represent XBT drops; heavy lines represent bottom topography.



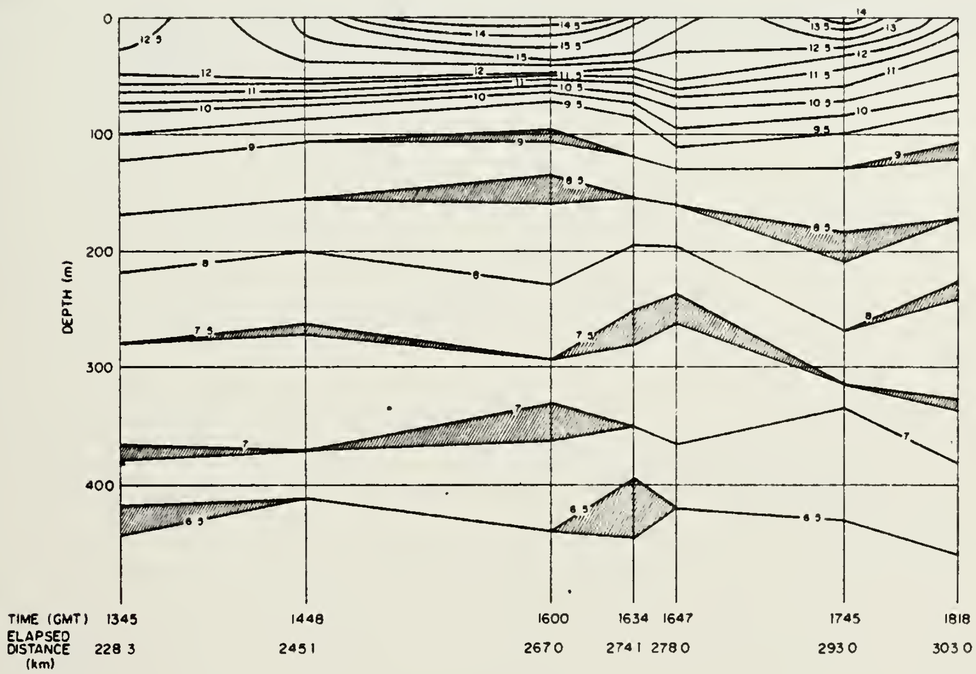


Fig. 23 (cont'd) Vertical temperature sections along the track of the November 1979 cruise [Johnson, 1980]. Vertical lines represent XBT drops; heavy lines represent bottom topography.

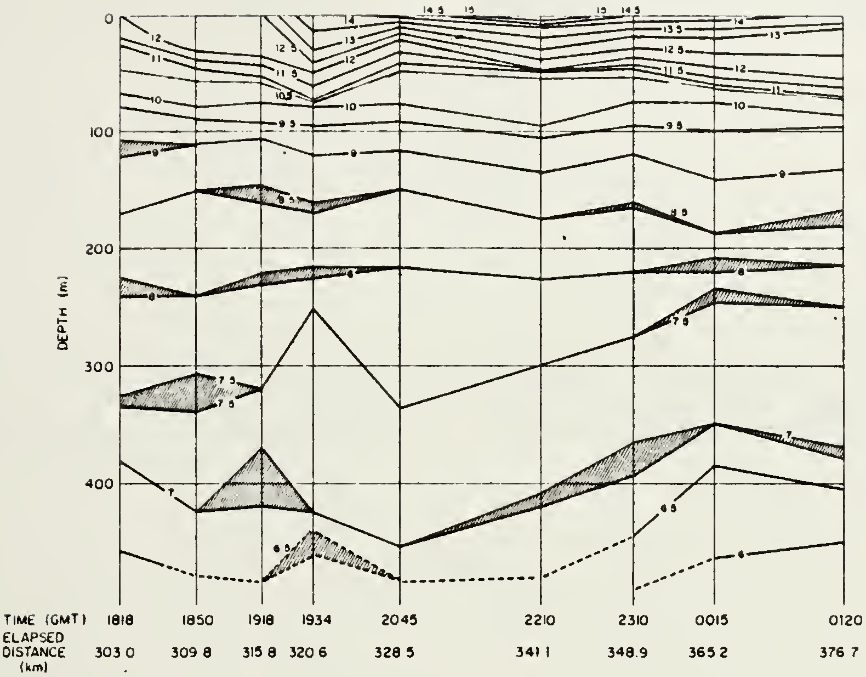


Fig. 23 (cont'd) Vertical temperature sections along the track of the November 1979 cruise [Johnson, 1980]. Vertical lines represent XBT drops.

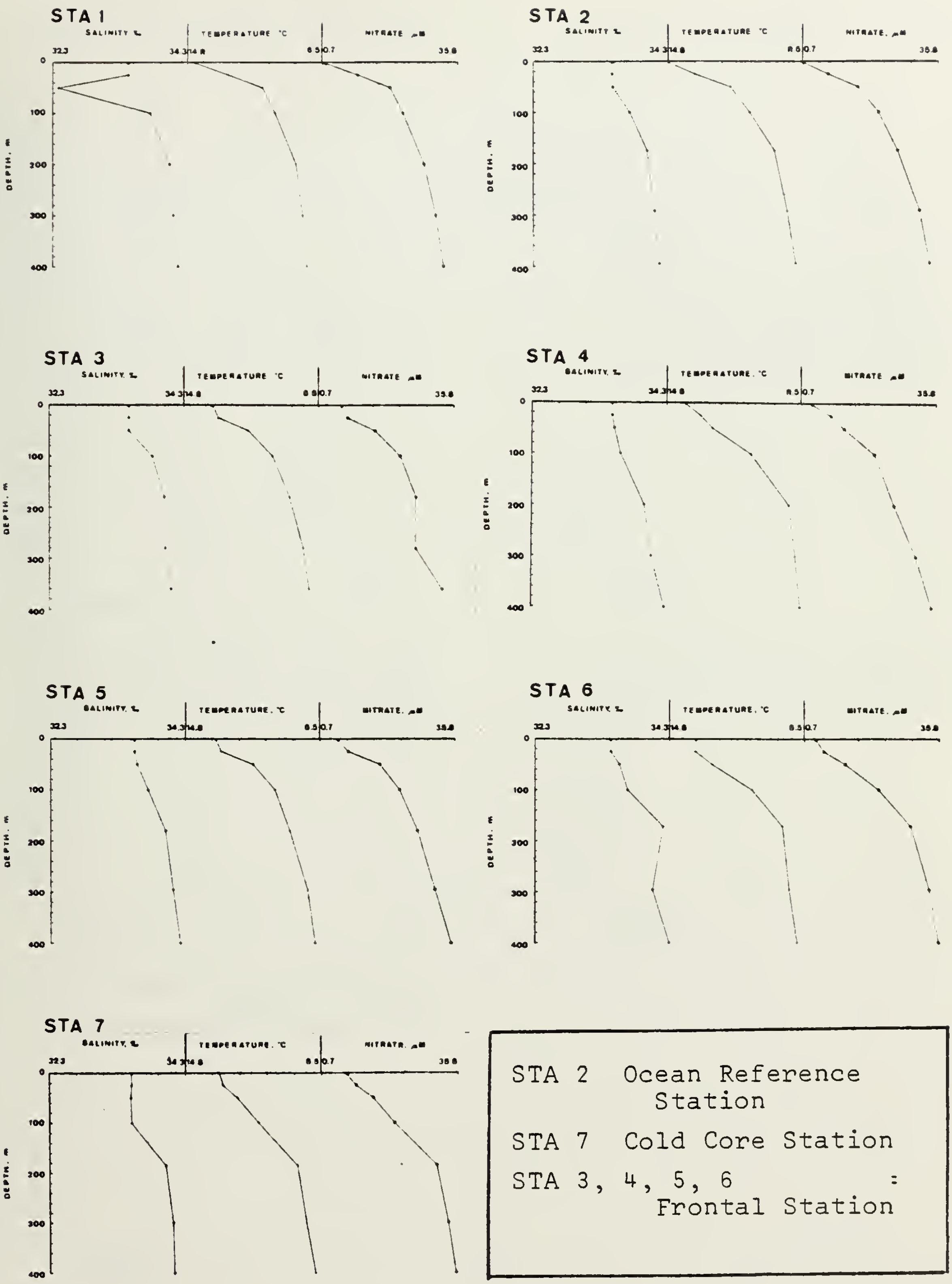


Fig. 24 Salinity, temperature, and nitrate versus depth at seven stations on the November 1979 cruise.

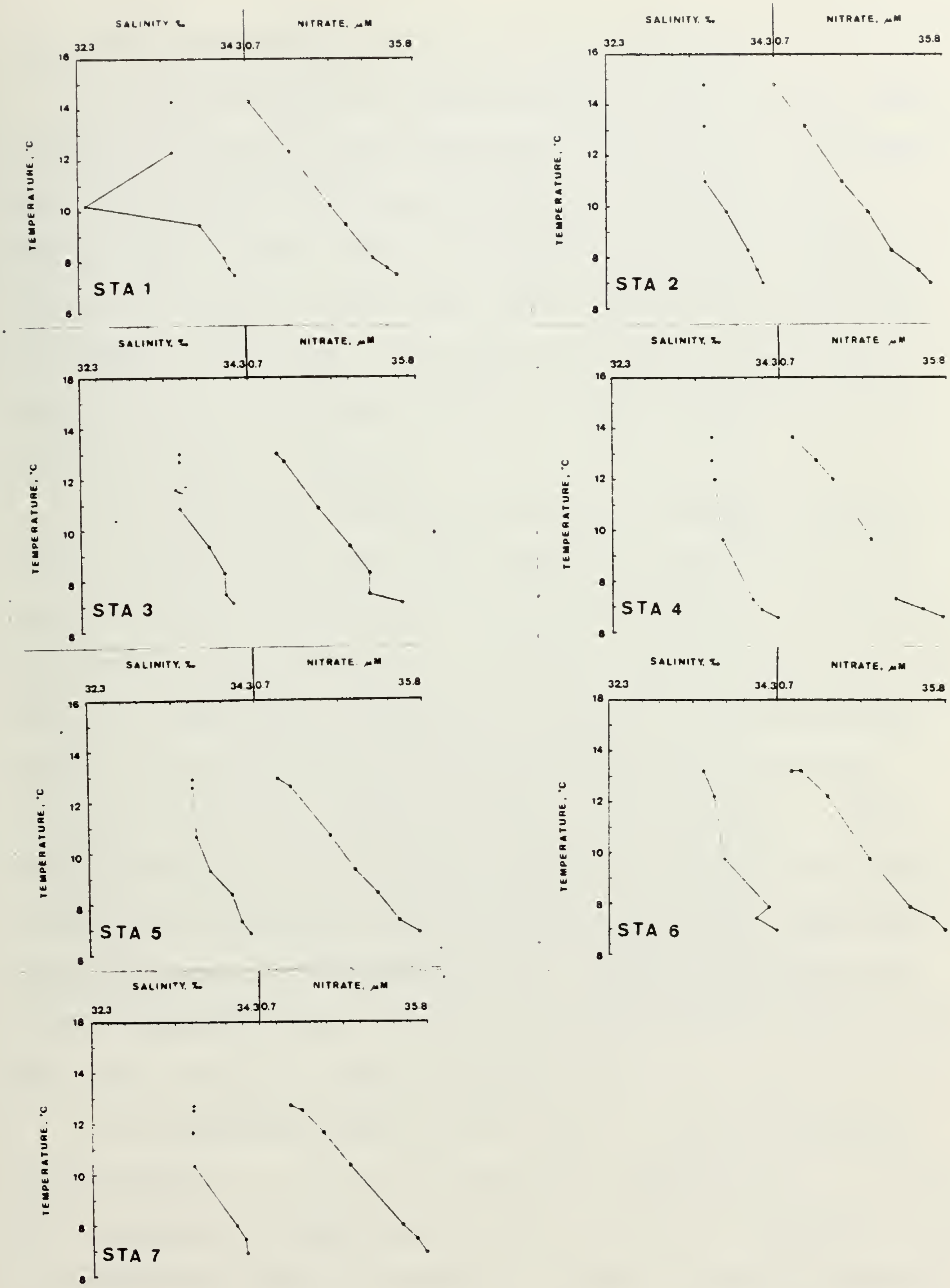


Fig. 25 T - S and T - N diagrams of seven stations on the November 1979 cruise.

C. JUNE 1980 CRUISE

Satellite monitoring of the waters off Pt. Sur on 9 June indicated a pulse of upwelled water had surfaced just before the ship departed Monterey en route to the study area. Plate 3 was the best image of the surface thermal feature, taken at 2242 GMT 9 June 1980, four hours prior to the commencement of the study. The wind during the study period, June 10 and 11, averaged between 11 and 13 $m \cdot sec^{-1}$ and was blowing from the northwest.

With the feature located by satellite thermal patterns, a five-pointed star track was planned so that crossings of the feature and coastal upwelling could be made. By halving the ship's speed during front transits, finer resolution data was to be obtained to compare the poleward and equatorward fronts for differences in thermal and nutrient gradients. The cruise plan was modified because of rough seas. After three crossings of the feature, the front analysis was given priority. A modified ladder track maneuvered the ship back and forth across the oceanic front. Before concluding the study, the ship transected the upwelling along its major axis. The ship's track is shown in Figure 26.

The correlation coefficients were $r = 0.96$ for nitrate to phosphate, $r = -0.96$ for nitrate to temperature, $r = -0.92$ for phosphate to temperature, and $r = -0.96$ for nutrient ratio to temperature (Figs. 27 and 28). Linear regression analyses between the above parameters yielded slopes of 18.05, -4.24,

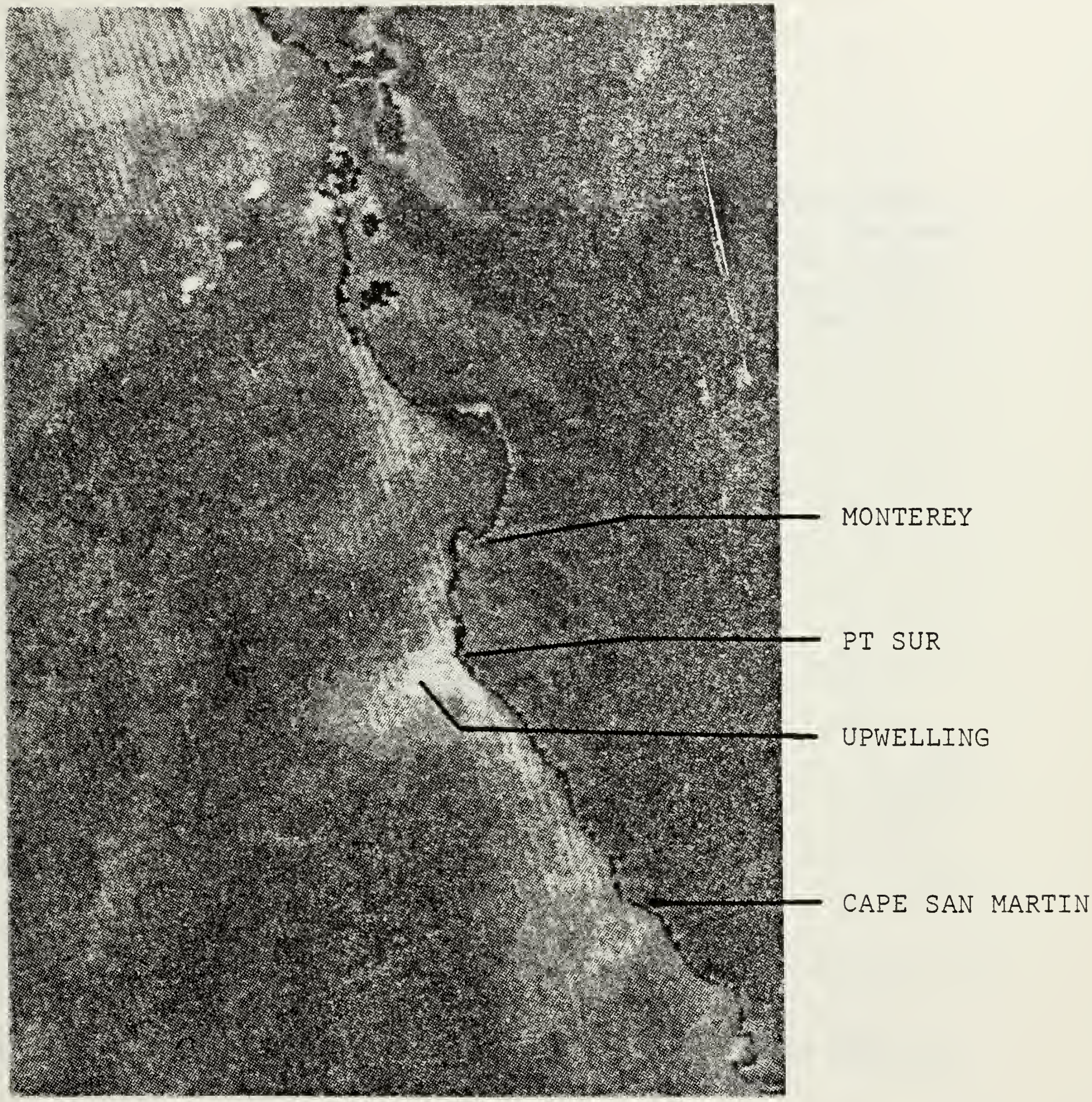


Plate 3. TIROS-N satellite image of the California coast for 9 June 1980.

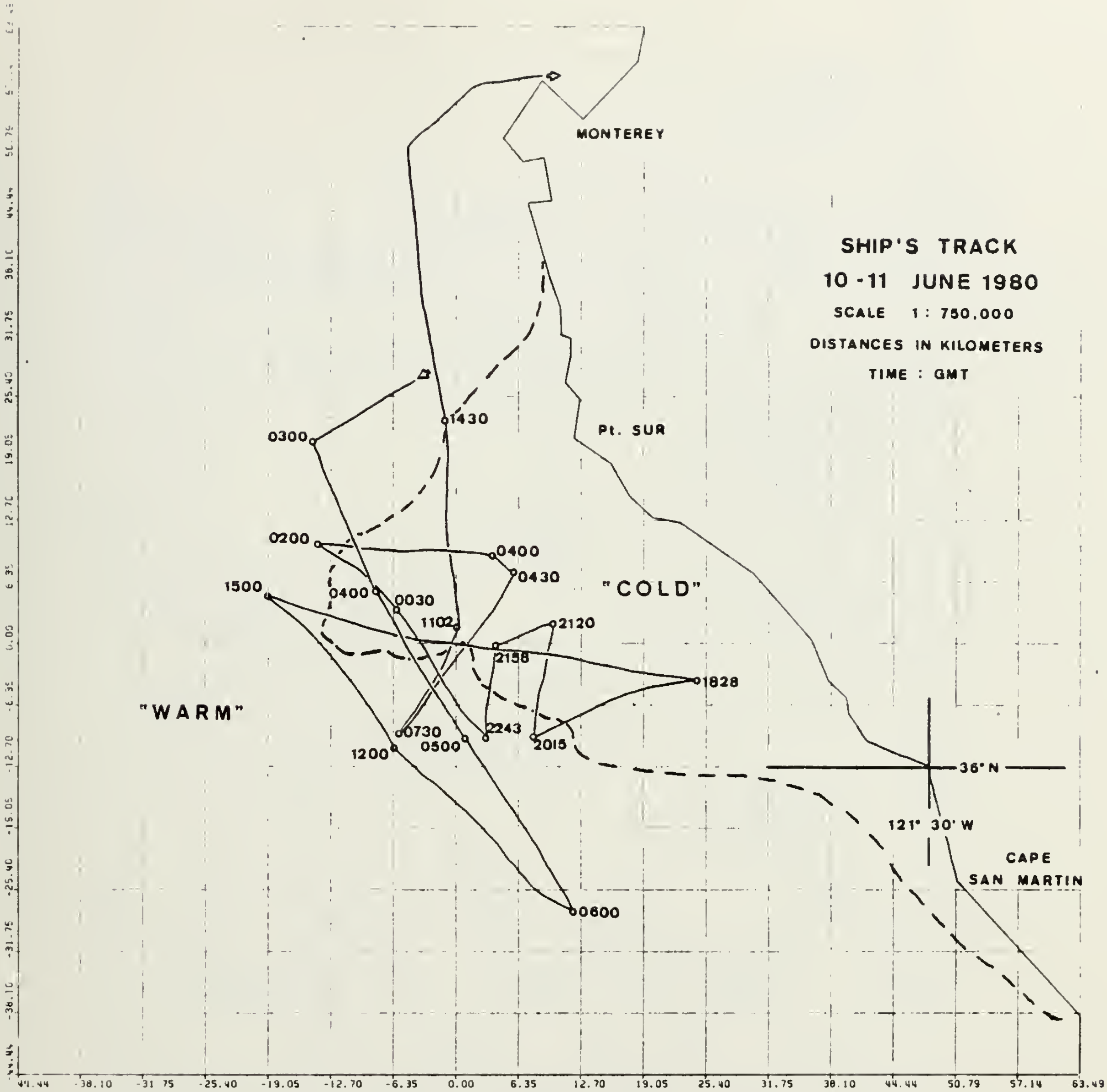


Fig. 26 Track of the June 1980 cruise and outline (dashed line) of the oceanic front.

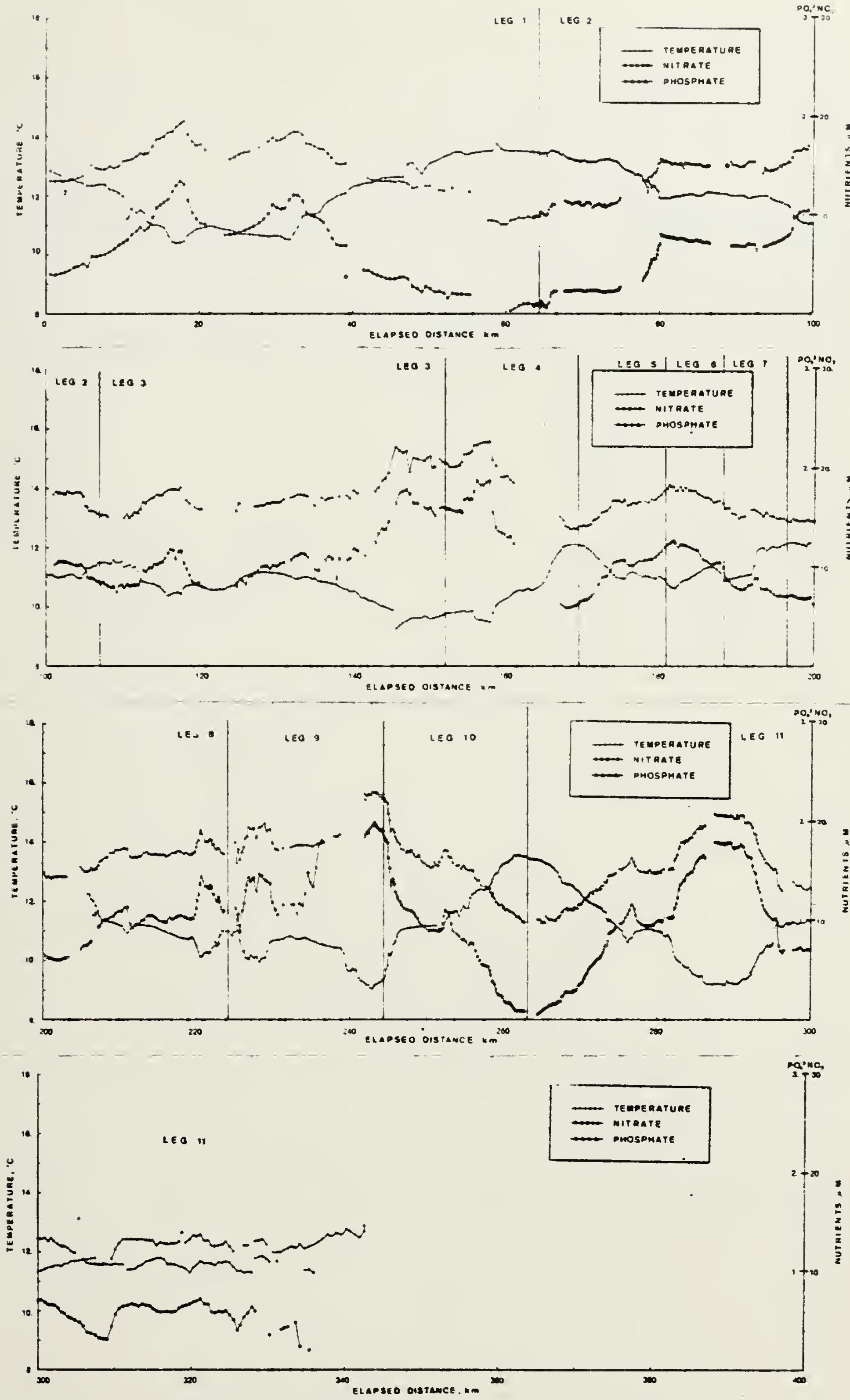


Fig. 27 Nitrate, phosphate, and sea surface temperature versus elapsed distance along the track of the June 1980 cruise.

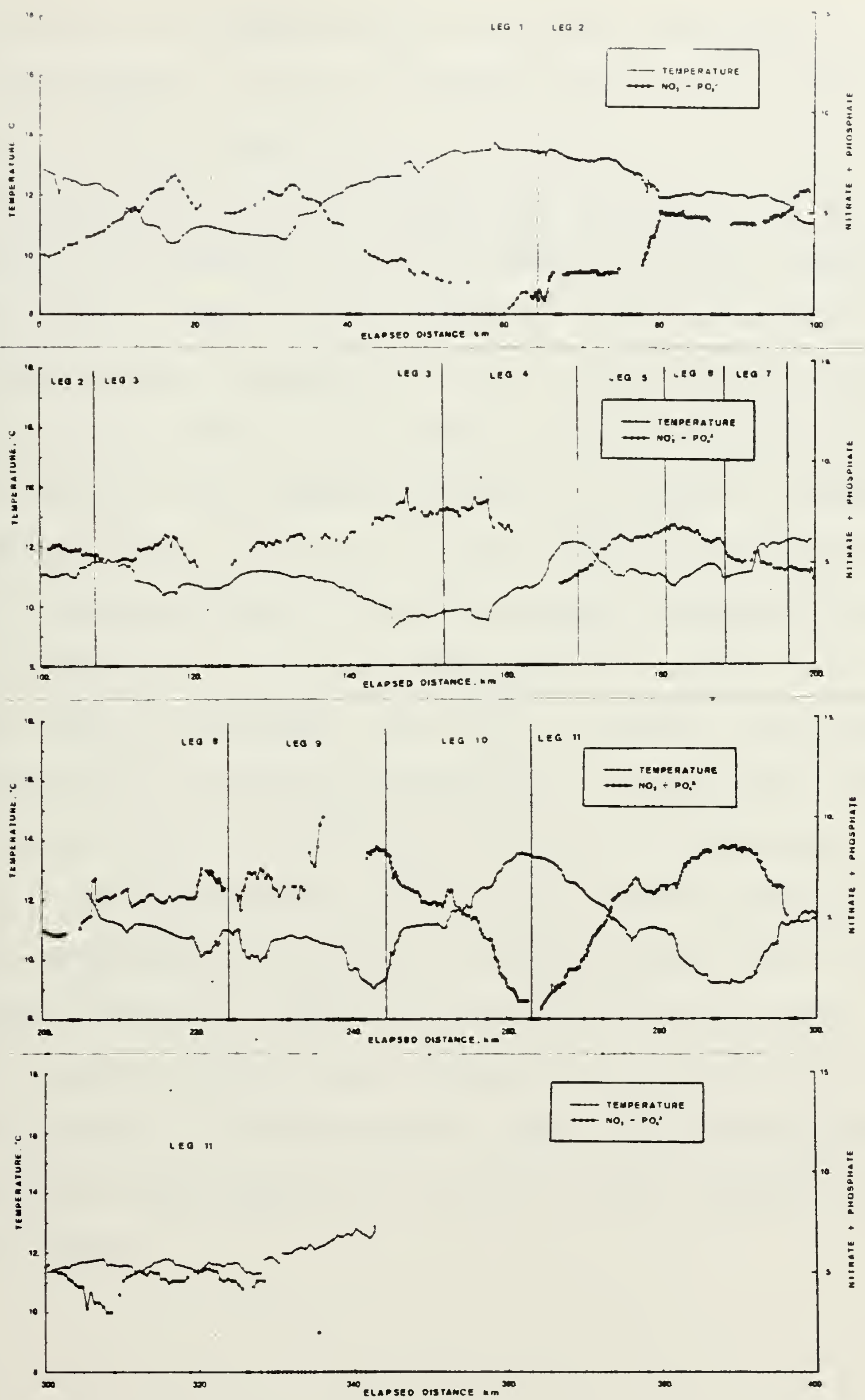


Fig. 28 Nutrient ratio and sea surface temperature versus elapsed distance along the track of the June 1980 cruise.

-0.64, and -2.07 respectively, and x-axis intercepts of 1.07 µM phosphate, 13.47°C, 13.88°C, and 13.97°C respectively (Figs. 29, 30, 31, and 32).

The major axis of the thermal and nutrient patterns are parallel to and directly over the axis of the Sur submarine canyon (Figs. 1, 33, 34, 35, and 36). The leading edge of the thermal feature appeared to curl cyclonically in the vicinity of the head of Sur submarine canyon. The crossing of the oceanic front appeared to have occurred at elapsed distances 14, 36, 112, 158, 172, 206, and 222 km (Fig. 37).

The sharp and well defined thermal and chemical gradients at the front seem to be less than in the November feature but greater than in September (Table II). However, the spread of temperature and nutrient concentrations is the widest for the June cruise; 13.77 to 9.04°C, 0.29 to 19.98 µM nitrate, and 0.91 to 2.31 µM phosphate. The oceanic front appeared to closely approximate the 11.5°C, 8.8 µM nitrate, and 1.6 µM phosphate isolines. Figure 26 shows the oceanic front.

The vertical temperature profile was generated from 23 XBT profiles. The thermocline under the upwelling was discontinuous and appeared to surface in the vicinity of the oceanic front.

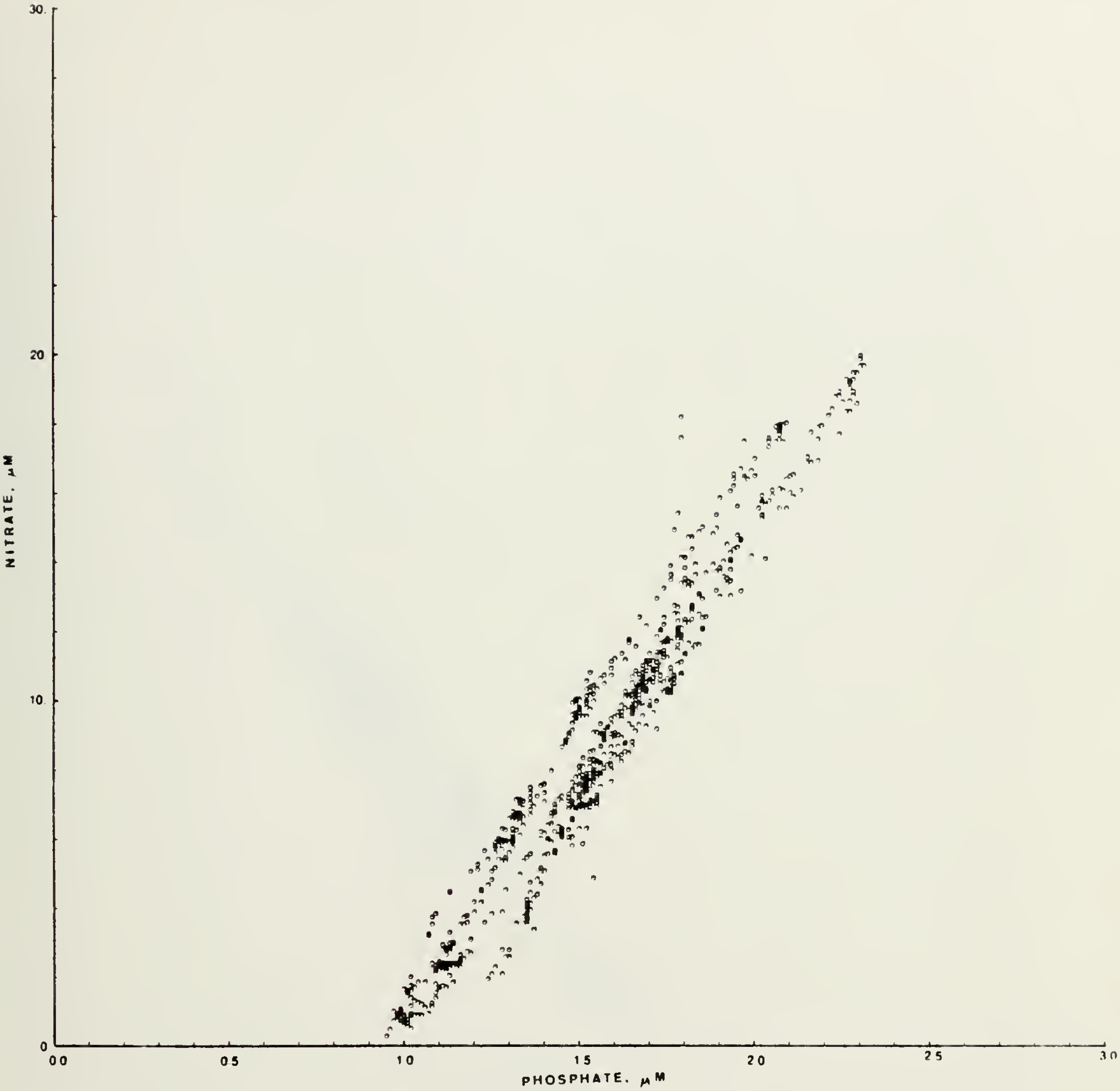


Fig. 29 Nitrate versus phosphate for the June 1980 cruise.

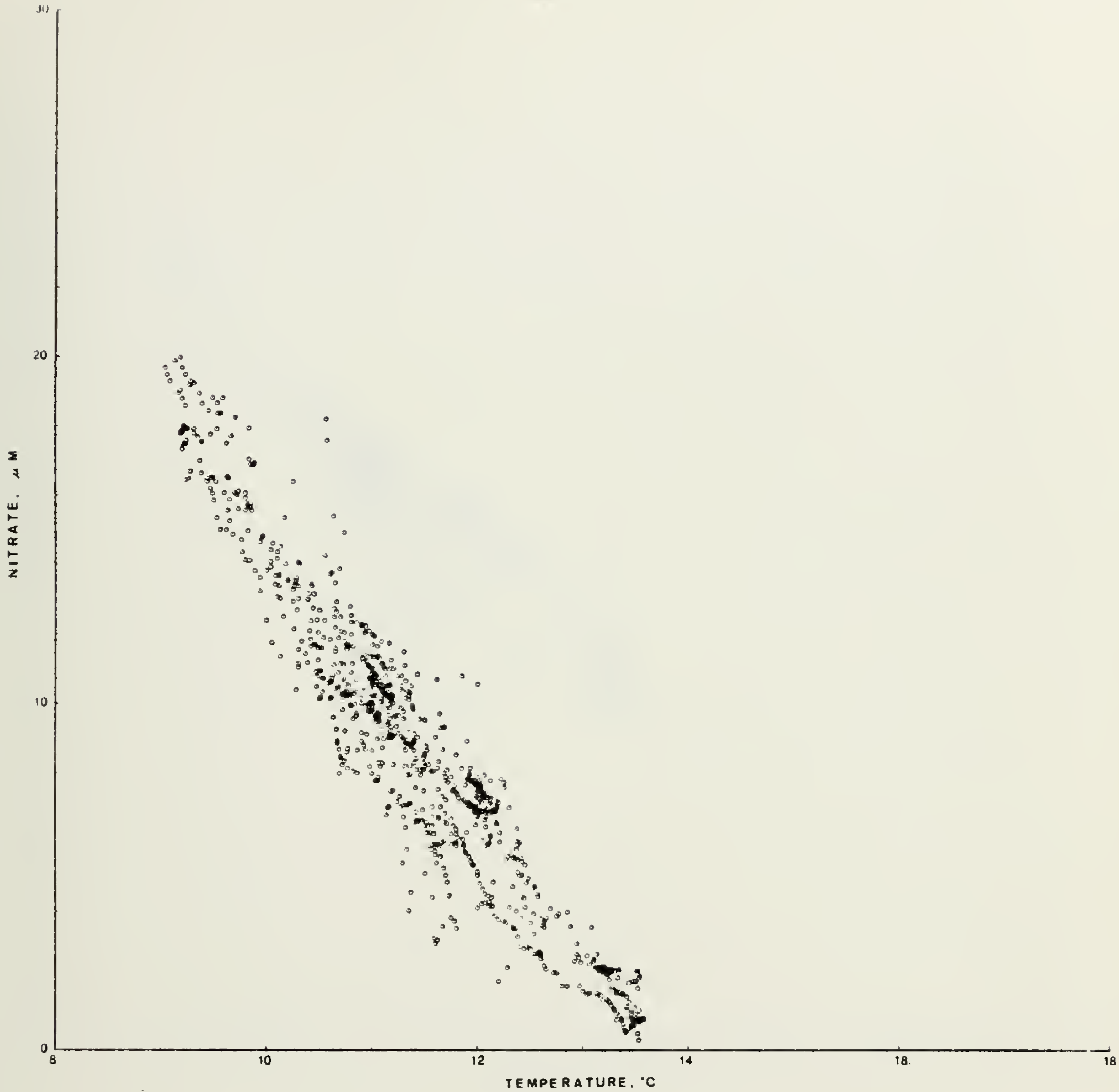


Fig. 30 Nitrate versus temperature for the June 1980 cruise.

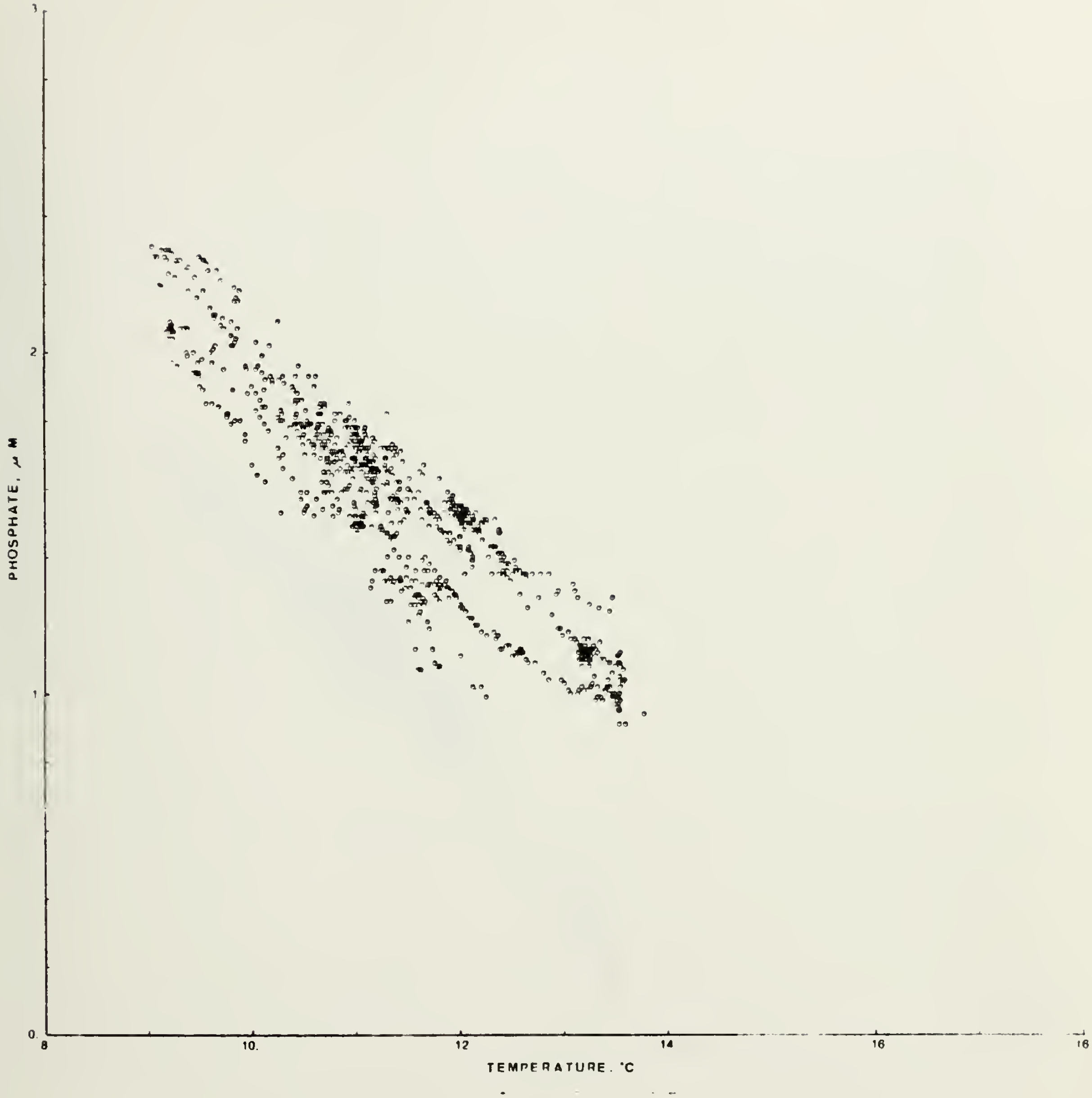


Fig. 31 Phosphate versus temperature for the June 1980 cruise.

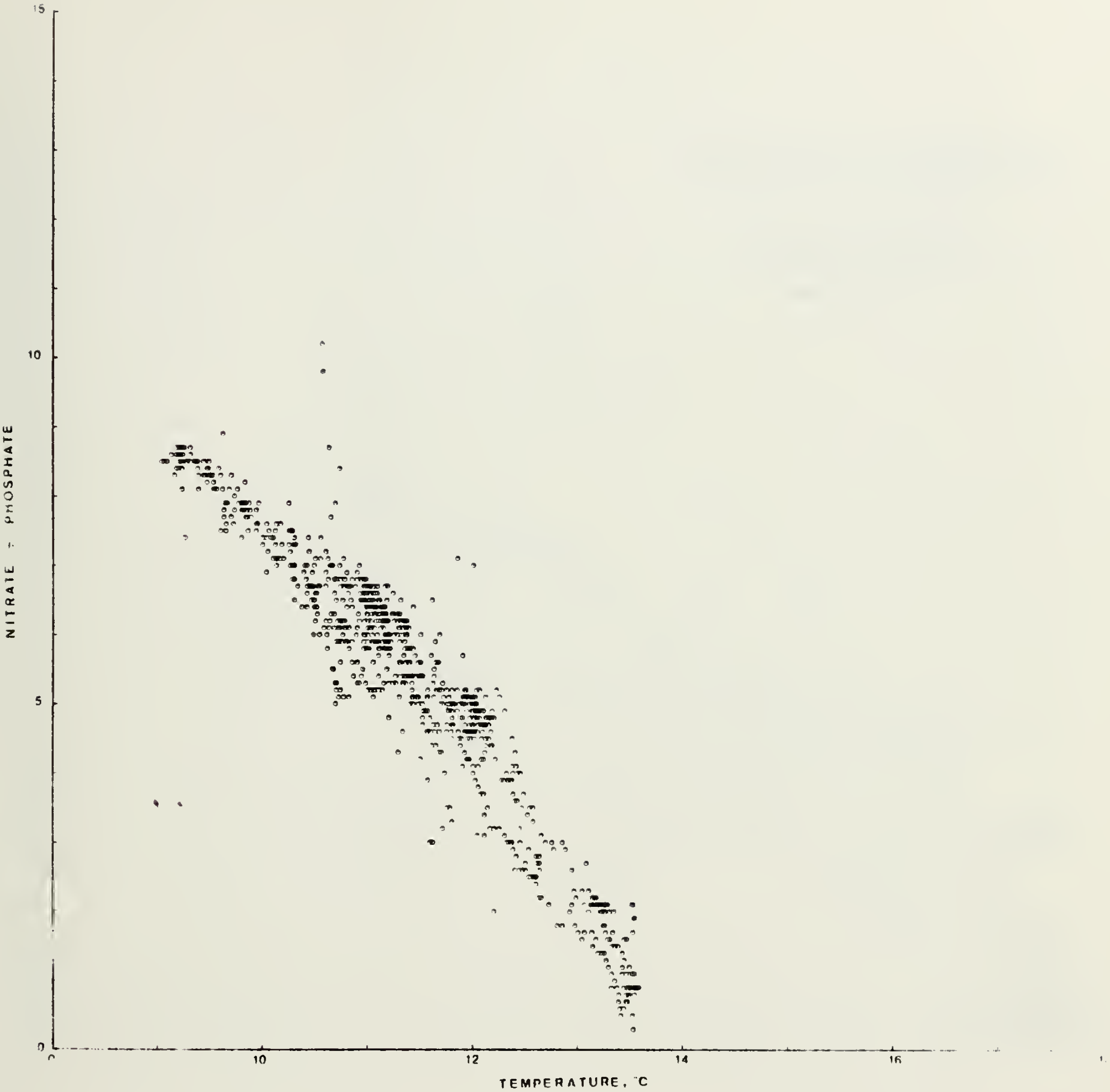


Fig. 32 Nutrient ratio versus temperature for the June 1980 cruise.

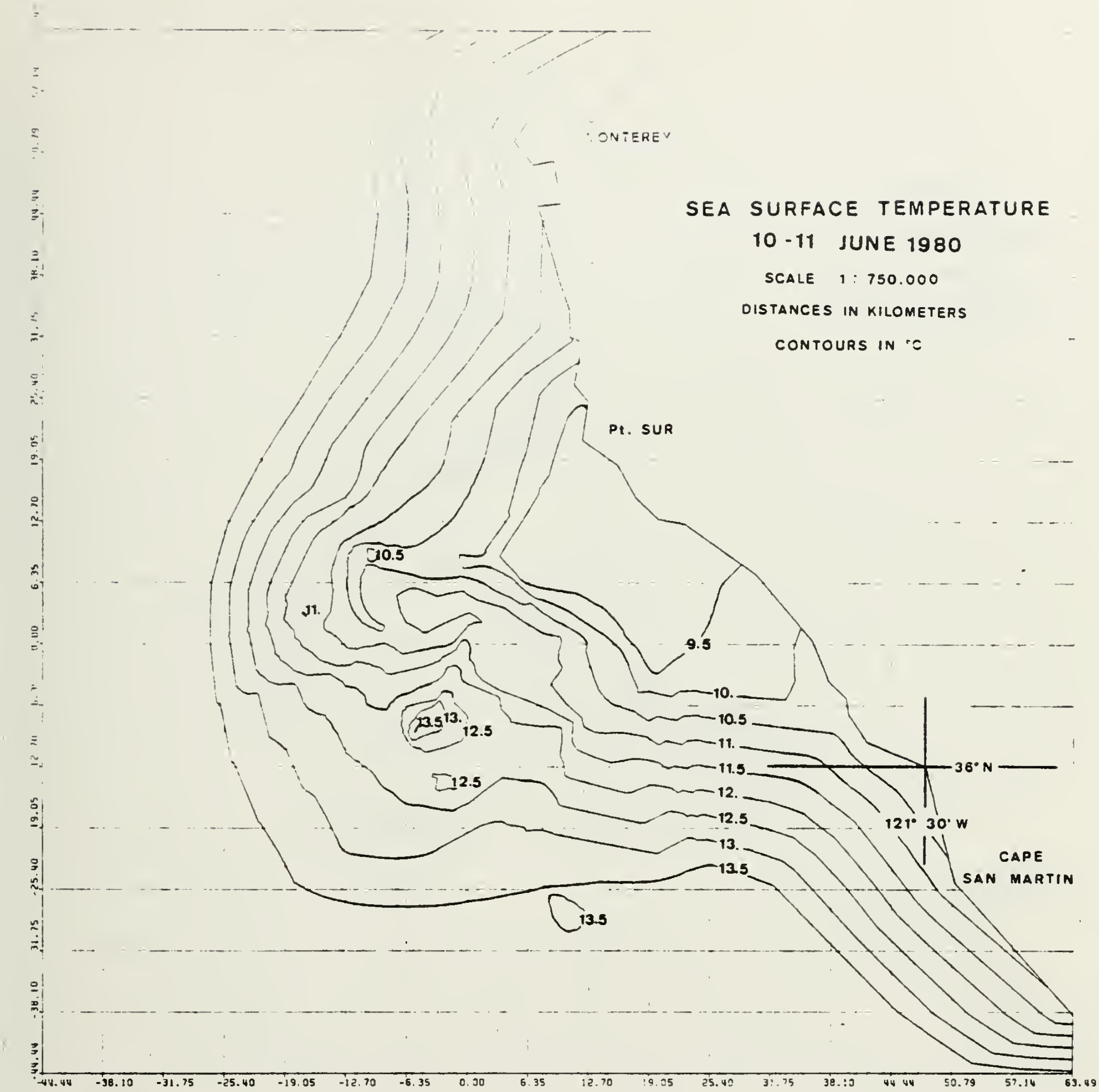


Fig. 33 Sea surface temperature map for the June 1980 cruise (contour interval, 0.5°C). Map generated from <u>in situ</u> data aided by IR imagery.

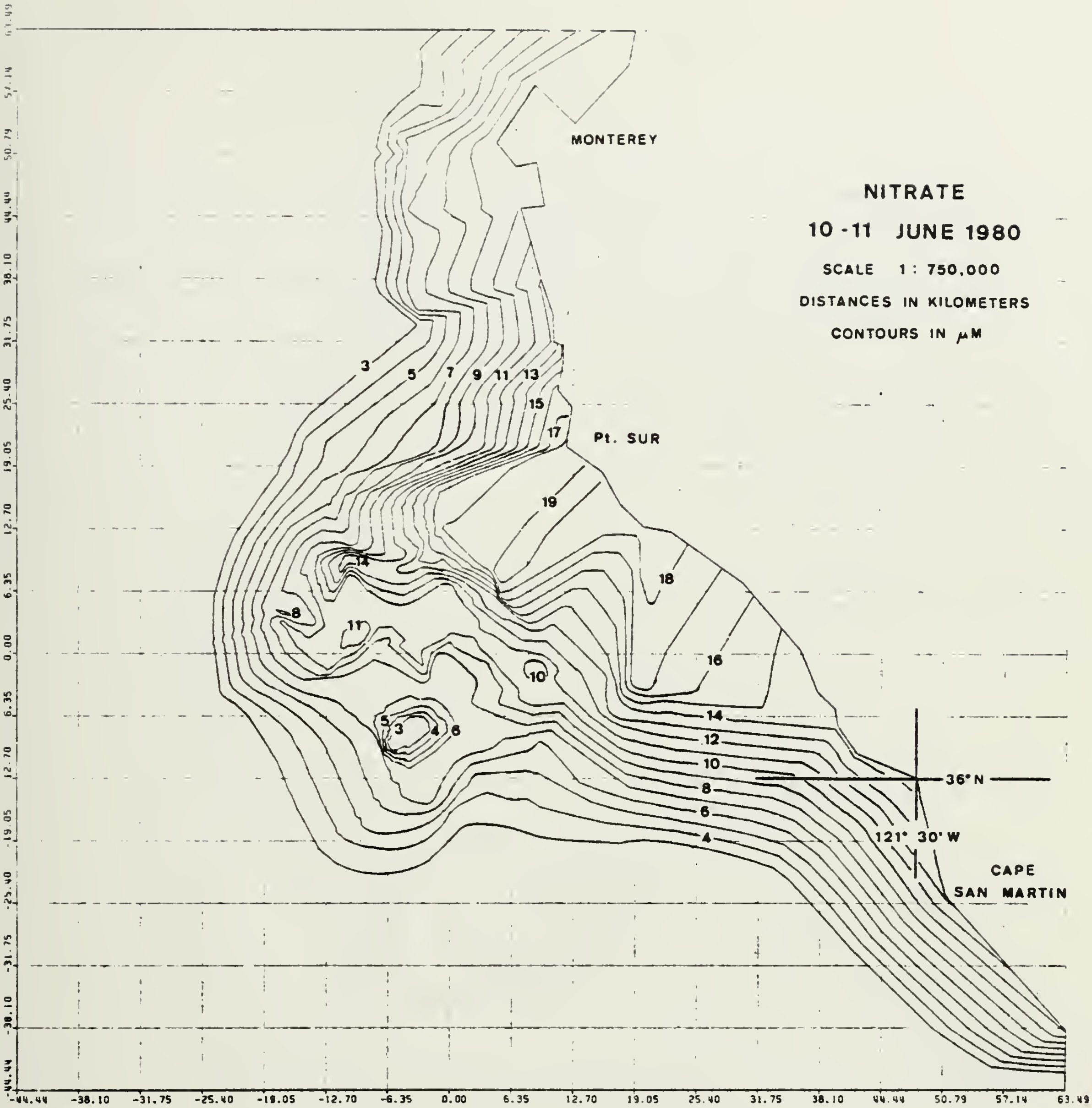


Fig. 34 Surface nitrate map for the June 1980 cruise (contour interval, 1 μM nitrate). Map generated by in situ data aided by inferences from IR imagery.

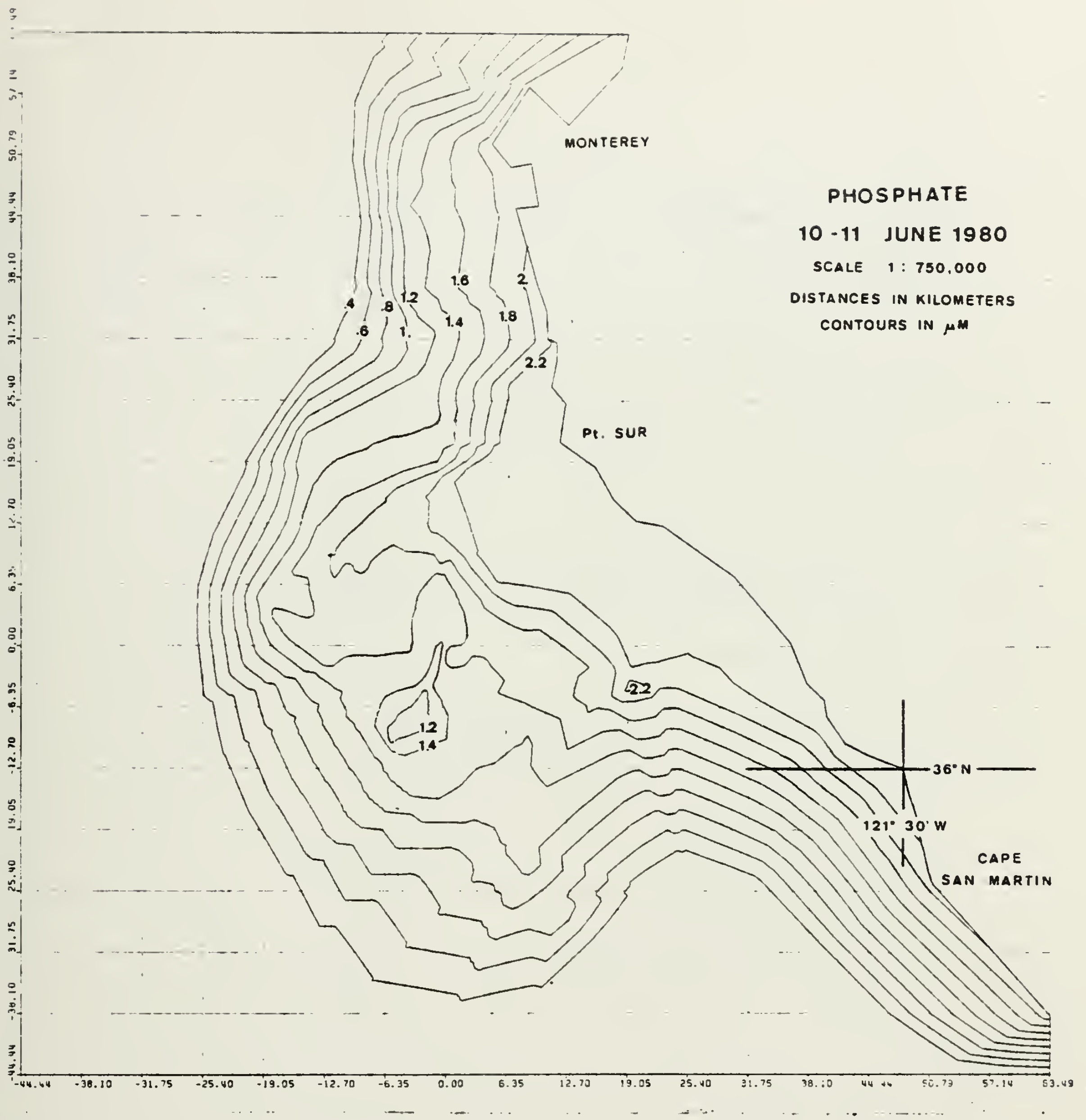


Fig. 35 Surface phosphate map for the June 1980 cruise (contour interval, 0.2 μM phosphate). Map generated from <u>in situ</u> data aided by inferences from IR imagery.

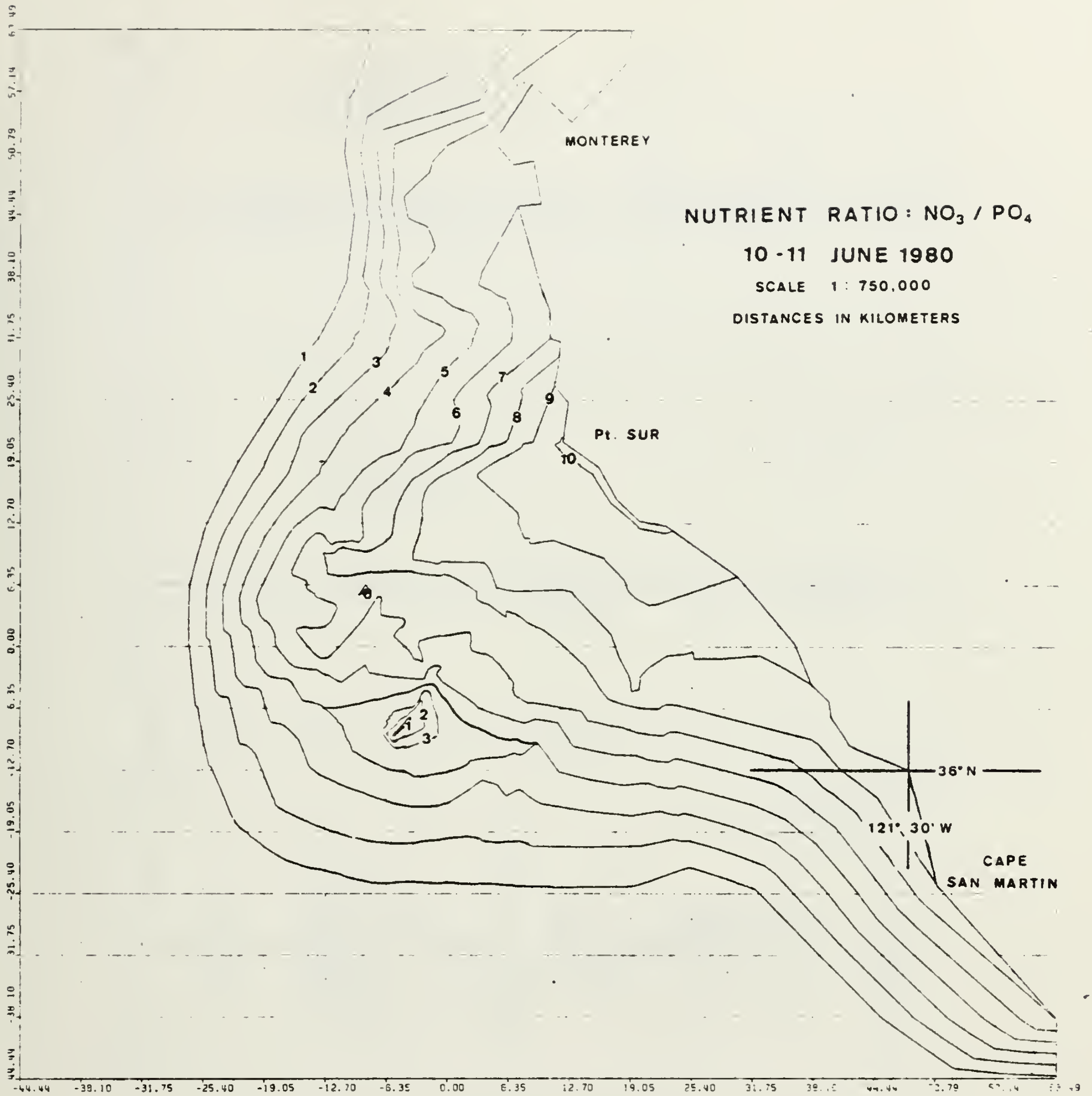


Fig. 36 Surface nutrient ratio map for the June 1980 cruise (contour ratio interval, 1). Map generated from <u>in situ</u> data aided by IR imagery.

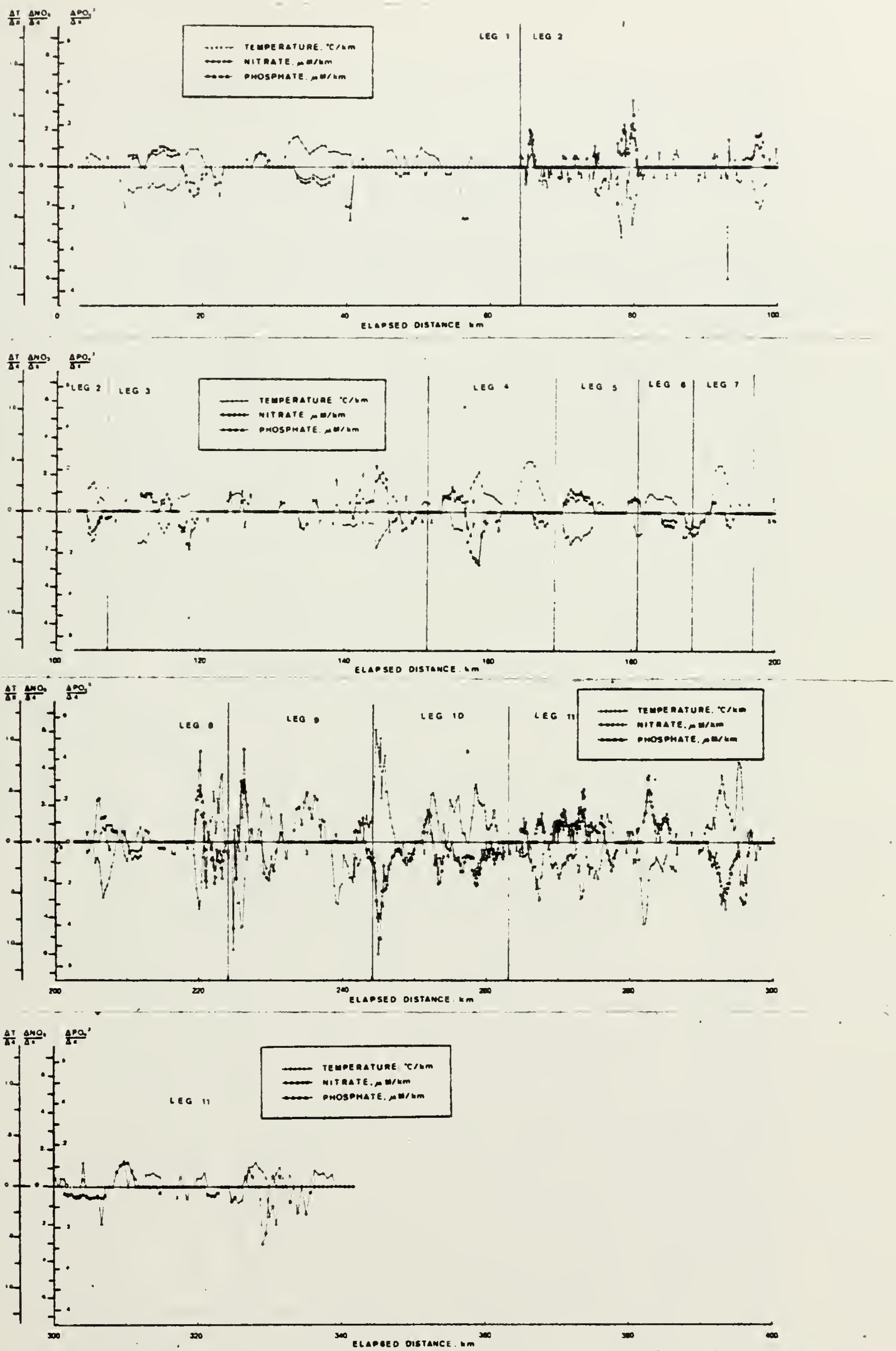


Fig. 37 Incremental change per kilometer of temperature, nitrate and phosphate versus elapsed distance along the track of the June 1980 cruise. Frontal transits occur at peaks.

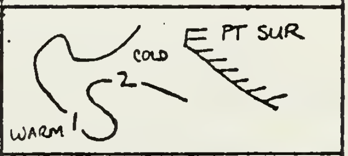
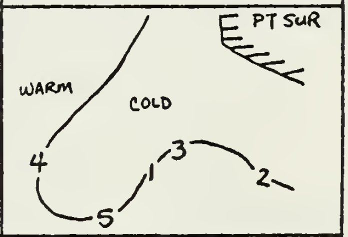
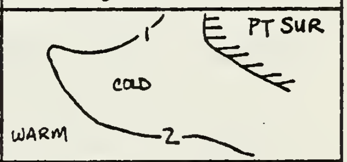
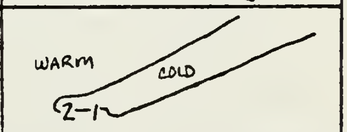
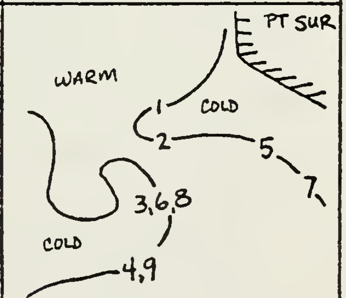
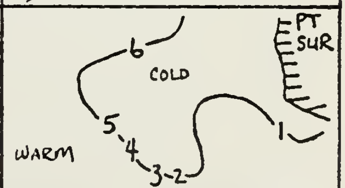
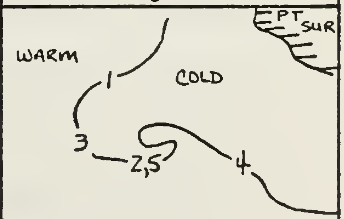
TABLE I

LINEAR REGRESSION ANALYSIS

CRUISE	SPREAD OF OBSERVED VALUES				SLOPE			X-INTERCEPT			CORRELATION		
	T °C	μM NO_3^-	μM PO_4^{-3}	NO_3^- / PO_4^{-3}	NO_3^- / T	PO_4^{-3} / T	NO_3^- / PO_4^{-3}	NO_3^- / T °C	PO_4^{-3} / T °C	NO_3^- / PO_4^{-3} μM PO_4^{-3}	NO_3^- / T	PO_4^{-3} / T	NO_3^- / PO_4^{-3}
DEC 79	9.60 to 12.70	2.64 to 23.16	0.47 to 1.93	3.8 to 12.4	- 6.98	- .73	13.38	12.91	13.11	0.33	-.96	-.92	.90
MAR 79	11.00 to 12.30	1.11 to 12.10	0.58 to 1.54	1.9 to 8.2	-12.19	-1.86	10.22	12.09	12.17	0.46	-.84	-.79	.93
APR 79	9.40 to 13.60	0.29 to 23.11	0.42 to 2.06	0.5 to 11.5	- 6.48	- .64	16.54	12.99	13.33	0.58	-.96	-.96	.97
JUN 79	11.14 to 13.83	0.55 to 12.10	0.33 to 1.29	1.7 to 12.3	- 4.99	- .48	18.52	13.79	14.01	0.45	-.92	-.93	.93
AUG 79	12.23 to 17.20	0.14 to 20.91	0.03 to 2.07	0.2 to 15.6	-13.63	- .93	15.34	15.35	15.99	0.52	-.24	-.69	.27
SEP 79	14.80 to 17.05	0.01 to 4.36	0.03 to 0.96	0.0 to 6.3	- 2.66	-1.00	13.85	16.68	16.77	0.45	-.91	-.66	.78
NOV 79	11.85 to 15.50	0.12 to 9.92	---	---	- 3.24	---	---	14.74	---	---	-.93	---	---
JUN 80	9.04 to 13.77	0.29 to 19.98	0.91 to 2.31	0.3 to 10.2	- 4.24	- .64	18.05	13.47	13.88	1.07	-.96	-.92	.96

TABLE II

GRADIENTS AND OBSERVED VALUES AT THE OCEANIC FRONT

CRUISE	POSITION	GRADIENT AT FRONT $T\ ^{\circ}C$ / km	GRADIENT AT FRONT $\mu M\ NO_3^-$ / km	GRADIENT AT FRONT $\mu M\ PO_4^{-3}$ / km	OBSERVED VALUES AT FRONT $T\ ^{\circ}C$	OBSERVED VALUES AT FRONT $\mu M\ NO_3^-$	OBSERVED VALUES AT FRONT $\mu M\ PO_4^{-3}$	POSITION ON FRONT WHERE GRADIENTS AND VALUES MEASURED
DEC 79	1 2	0.17 0.38	1.09 2.87	0.07 0.16	11.2 11.1	9.0 10.0	1.0 1.0	
APR 79	1 2 3 4 5	0.38 0.34 0.31 0.34 0.29	2.13 1.74 1.43 1.93 2.33	0.15 0.10 0.09 0.13 0.13	10.5 11.9 10.5 10.8 11.2	14.8 8.7 15.9 11.6 12.8	1.4 1.2 1.5 1.3 1.3	
JUN 79	1 2	0.45 0.44	2.05 2.56	0.12 0.19	13.2 13.4	7.1 1.2	0.7 0.4	
AUG 79	1 2	0.41 0.39	1.56 0.83	0.08 0.04	15.5 16.5	7.0 4.0	0.8 0.8	
SEP 79	1 2 3 4 5 6 7 8 9	0.20 0.17 0.33 0.12 0.15 0.21 0.18 0.20 0.16	0.29 0.37 0.60 0.44 0.41 0.60 0.37 0.49 ---	0.01 0.05 0.04 0.04 0.04 0.04 0.03 0.04 0.06	15.9 15.7 16.0 16.4 15.9 15.9 16.0 16.0 15.7	1.3 1.8 2.3 1.4 1.5 1.7 0.6 2.6 ---	0.6 0.6 0.7 0.6 0.5 0.5 0.6 0.6 0.8	
NOV 79	1 2 3 4 5 6	0.45 0.76 0.51 0.76 0.45 0.35	1.66 2.69 2.05 2.28 0.77 1.21	--- --- --- --- --- ---	14.2 14.4 14.1 13.9 14.2 13.4	1.5 2.5 2.2 4.8 1.9 2.5	--- --- --- --- --- ---	
JUN 79	1 2 3 4 5	0.27 0.33 0.32 0.32 0.59	1.28 1.07 0.97 1.25 2.49	0.09 0.06 0.09 0.08 0.09	11.1 11.6 11.1 11.6 12.1	9.8 9.0 8.6 8.4 8.3	1.7 1.7 1.6 1.5 1.5	

IV. DISCUSSION

A. SATELLITE DETECTED THERMAL PATTERNS COMPARED TO IN SITU SURFACE MAPS

Inferring the distribution of surface nutrient concentrations from surface thermal patterns detected by satellites appear feasible from the correlation of in situ nutrients and temperature. In this study sea surface nutrient maps were generated for comparison with satellite detected thermal patterns formed by upwelling systems off Pt. Sur, California. For example, the surface nitrate and phosphate maps for the June 1980 feature (Figs. 34 and 35) appear similar to the thermal distribution (Fig. 33) with regard to the general location of the nutrient feature, its center, and the orientation of the major axis. However, the nutrients exhibited a highly structured pattern with sharp gradients within the feature which was not predictable from the satellite image. The magnitude of the difference between the distribution implied by the image and the actual surface distribution of nutrients within the feature varied among the April, September, November 1979 and June 1980 upwelling systems. (The other features lacked sufficient data to construct surface nutrient maps.) The thermal and spatial resolution of the AVHRR (1°C and 1.1 km respectively) could account for some of the difference. However, the relative ranges of the

nutrient values compared to the range of the temperature varied too much in different features at different times to be satisfactorily explained by the lack of resolution alone.

B. NUTRIENT-TEMPERATURE CORRELATION AND "ACTIVE UPWELLING" SYSTEMS

To better evaluate these differences, regression analyses were applied to in situ values of nutrients and temperature within the different features which formed at different times of the year (Fig. 38). Although there were variations, the slopes for all features were negative. A strong inverse linear correlation existed in five of the seven features observed since December 1978 (Table I). This implied that regression lines between nutrients and temperature might be useful in describing the distribution of nutrients with respect to surface temperature patterns. The variations in slope of these regression lines suggests that the relationship of nutrients to temperature might depend on numerous factors. These may include the temperature and nutrient characteristics of the source water, the depth from which the water was advected, wind stress and bathymetric effects, surface dynamic processes (viz., mixing, advection, and heat exchange) and biological processes. Because of the complexity of the problem, trends were investigated with a view toward developing indices for prediction of nutrient distribution.

The strong inverse correlations between temperature and nutrients occurring in five cruises suggested that 'active

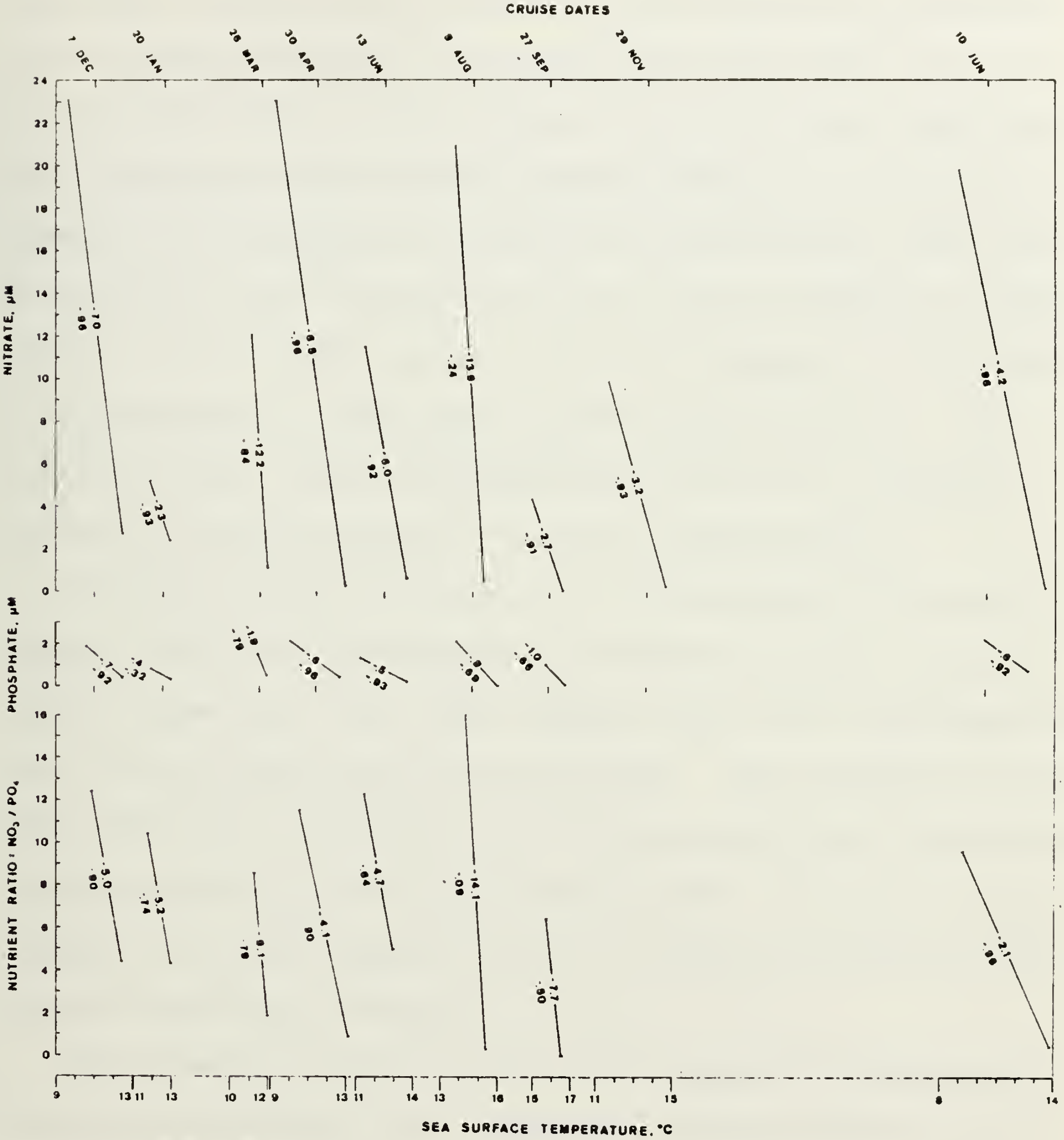


Fig. 38 Summary of regression lines for nitrate, phosphate, and nutrient ratio versus temperature 7 DEC 1978 - 10 JUN 1980. 20 JAN, oceanic water; 7 DEC, 30 APR, 8 AUG, and 10 JUN upwelled water from below thermocline; remaining cruises "upwelled" water from above thermocline.

upwelling' systems had occurred. This was readily apparent for the April 1979 and June 1980 cruises for which the vertical temperature profiles showed the thermocline surfacing near the edge of the surface thermal feature. This break, through the thermocline, would have permitted the advection of nutrient-rich, "biochemically new" water [Traganza et al., 1980], to the surface waters within the feature. This seems to be supported by the high nutrient concentrations, high nutrient ratios, and low temperatures below 10°C observed inside the feature (Figs. 27 and 28, respectively).

Although satellite history of the November 1979 cruise suggests the observed feature was sampled during a stage of 'active upwelling', XBT data indicate that the system appeared not to have penetrated the thermocline. The thermocline under the feature was continuous and did not appear to be perturbed by the shallow (ca. 50m) upwelling system. This would have accounted for the moderate level of nitrate observed at the surface inside the feature.

The December 1978 and June 1979 cruises did not collect vertical temperature data. From the wind data and the moderate levels of nitrate and phosphate, the upwelling system observed on the June 1979 cruise was assumed 'active' [Conrad, 1980]. Because the nutrient levels were similar in magnitude to the November 1979 cruise, this feature could be representative of a shallow upwelling.

As the December 1978 cruise had low temperatures, high nutrient concentrations and nutrient ratios similar to those of the April 1979 and June 1980 cruises, the feature observed could have been associated with a discontinuity in the thermocline permitting deep upwelling. Thus, strong linear correlations between nutrients and temperature may be assumed for 'active upwelling' systems.

C. THE RELATIONSHIP BETWEEN SOURCE WATER CHARACTERISTICS AND THE OCEANIC FRONT

The ability to determine the initial condition of the upwelled water was considered a major factor in prediction. The nutrients in this subsurface source water would provide the maximum nutrient concentrations observed in the upwelled surface water. The nutrient concentrations and temperature were expected to be a function of depth and ambient water mass. The depth of the source water is most likely tied to the duration and strength of wind or other forcing functions, e.g., internal waves [Johnson, 1980].

Within an 'active upwelling,' the surface is replenished by vertical advection of source water. The properties characteristic of the source water are confined to the surface feature by the oceanic front. For every feature studied, the maximum gradient analysis of in situ temperature and nutrients (see Methods: Definition of Front and Calculation of its Gradients) showed the nutrient fronts coincided within $\pm.6$ km to the thermal front (Figs. 14, 22, and 37). Thus, the thermal

front detected in satellite imagery closely approximates the nutrient front.

Since nutrients are linearly related to temperature, thermal gradients are well represented within a satellite image, and the nutrient fronts and thermal front coincide, the features were examined to see if the sharpness of the thermal front might reflect the range of nutrients within the feature.

The sharpness of the thermal front was not found to be a dependable measure of the nutrient distribution within a feature. The thermal gradients at the fronts of the December 1978, April and September 1979, and June 1980 features had similar magnitude, 0.12°C/km to 0.38°C/km (Table II). Within the December, April, and June features high concentrations, 8.3 to 23.1 μM nitrate and 1.0 to 2.3 μM phosphate were observed. These surface values were considered the result of 'active' deep upwelling. However, the September feature had significantly different nutrient concentrations, 0.6 to 4.3 μM nitrate and 0.5 to 0.9 μM phosphate. The vertical temperature profile of the September cruise showed a continuous though greatly perturbed thermocline under the surface feature (Fig. 15). The low nutrient concentrations and nutrient ratios, together with the vertical temperature date [see Johnson, 1980], suggest that a shallow upwelling or mixing in the upper layer caused the feature. The satellite history of the feature revealed the thermal patterns were becoming

indistinguishable at the time of the cruise. The lack of strong correlation in the nitrate to phosphate and nutrient to temperature regressions also suggested that the feature was dissipating. The June, August, and November 1979 features also showed differences between nutrient distributions despite their similar thermal fronts.

D. NUTRIENT DISTRIBUTION PREDICTION REQUIRES GROUND TRUTH

Because of the inability to describe adequately and therefore predict the nutrient distribution from satellite detected thermal patterns alone, ground truth data are needed. In that the linear correlation was strong between nutrients and temperature, an indicator of active upwelling, for the five features mentioned earlier, the sum effects of the initial conditions, boundary conditions, and dynamic processes appear confined to altering the slope of the nutrient to temperature regression line and its intercept.

E. THE FEASIBILITY OF SATELLITE PREDICTION AIDED BY LIMITED *IN SITU* SAMPLING

A test, therefore, was conducted to determine how good a satellite prediction could be, using source water temperature and nutrient characteristics in a regression equation to forecast surface nutrient concentrations. The regression line is bounded by the coldest temperature in the feature and the warmest oceanic water temperature.

1. Use of the Oceanic Water Temperature as an Intercept for a Predictive Regression Line

The temperature (T) intercepts computed from in situ nutrient/temperature regression equations were compared with the warmest oceanic temperature to determine if a trend could be seen that would be useful in developing a regression equation to forecast nutrient concentrations. The phosphate/temperature T-intercept was always greater (warmer) than the nitrate/temperature T-intercept. Because the oceanic environment appeared to be nitrate-limited (nitrate goes to zero while phosphate is still present, see Figs. 6 and 29), the phosphate/temperature line would have to be extrapolated to reach the temperature axis, thus greater (warmer) temperatures. This would be an over estimate of the actual oceanic water temperature. The difference, $T_{ocean} - T_{intercept}$, for active upwelling systems as defined by nutrient values and concentrations ranged from -0.21 to +0.61°C for nitrate/temperature and -0.18 to +0.27°C for phosphate/temperature regression equations (Table I). Within the thermal resolution (.5°C) of the satellite sensor, the T-intercept might therefore be considered equivalent to the temperature of the oceanic water.

2. Hypothesis That Nutrient/Temperature Relation within Source Water Is Linear

Strong linear correlations were seen between both nutrients and temperature and their gradients in the November

1979 shallow upwelling system and June 1980 deep upwelling system. From satellite history, these features appear to have been observed during an initial stage of development indicating the water upwelled from its source depth had been in contact with the surface for a day or less. Therefore, the source water nutrient and temperature characteristics should be linearly related. If this is the case, and the source water regression line is known (from recent or historical data), this relation could be used, along with the oceanic water temperature as a T-intercept, to provide a first approximation of the nutrient distribution reflected by the surface thermal patterns.

In order to test this hypothesis, source water characteristics were examined using T - S and T - N diagrams from the shallow upwelling November 1979 Nansen casts (Fig. 25). The 2 and 25m T - N samples for station 7 (located near the coldest water in the feature) and stations 3, 4, 5, and 6 (located near the front) were plotted on the T -N diagram for station 2, which was representative of the oceanic environment (Fig. 39). The 25m samples were tightly clustered on the station 2 curve between the 25 and 50m depths, suggesting that the water had upwelled from that depth. The 2m samples of the ocean front stations were skewed off the station 2 reference curve toward warmer, lower nutrient water. However, station 7 varied little between the surface and 25m depth. Apparently station 7 was nearest the area where the source

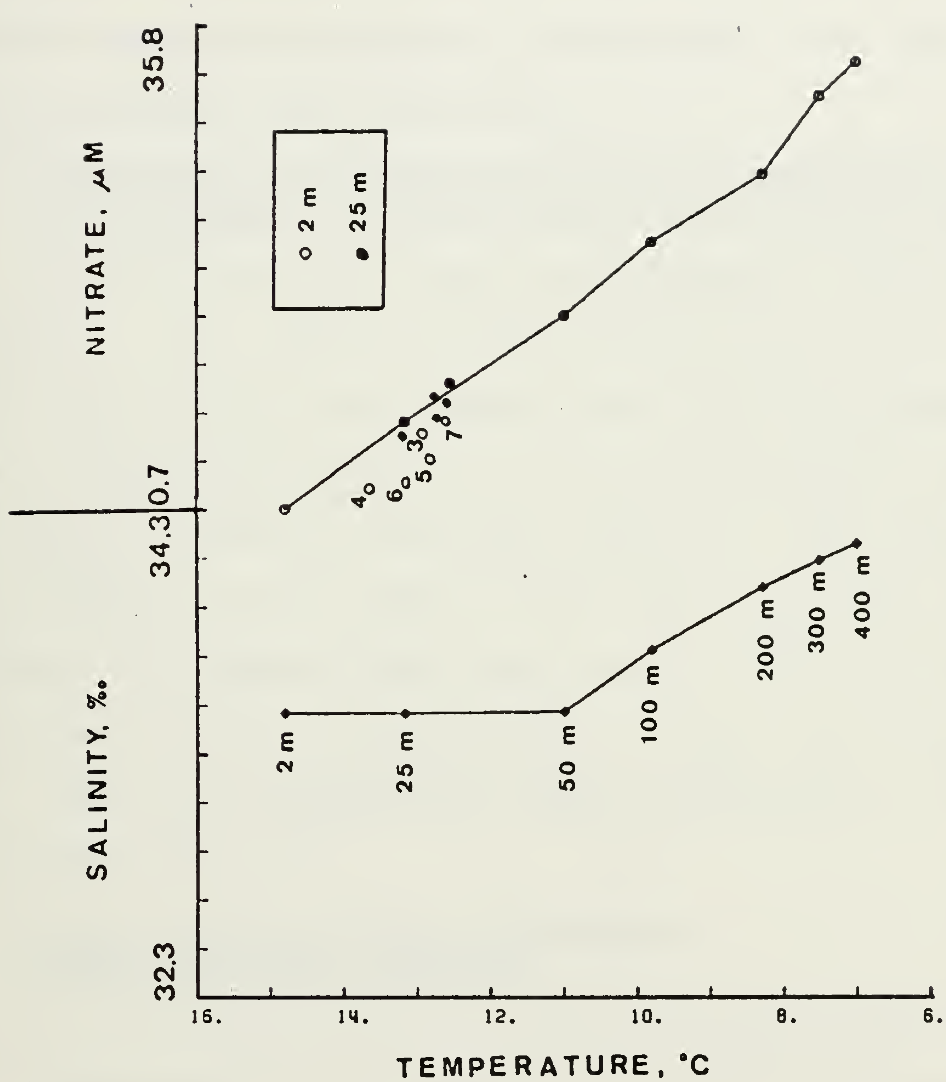


Fig. 39 T - S and T - N diagram for station 2; ocean reference, with 25m (solid circles) and 2m (open circles) data from stations 3, 4, 5, 6, and 7 added to identify source water.

water first came in contact with the surface. The ocean front station data were obtained in this source water after it had been affected by mixing, heat exchange, and other processes, dynamical and biological.

3. The Effects of Wind Mixing and Heat Exchange to the Atmosphere on Surface Water near Oceanic Front

The difference in 2 and 25m temperatures could be associated in part with the mixing caused by the 3 to $5 m \cdot sec^{-1}$ winds during the November cruise and the atmospheric thermal exchange associated with a low percentage of cloud cover and *ca*. 10 hours of daylight observed. Over the one day, the upwelled water known to have been in contact with the surface the longest (which was assumed to be the water at the oceanic front) was predicted to be *ca*. 0.8°C warmer [James, 1966]. This agreed with what was observed on the T - N diagram (Fig. 39).

4. Determination of Depth From Which Source Water Was Advected

It was postulated that a nutrient source depth range could be determined by the depths at which the cold temperature in the center of the feature, T_c, and the temperature of the ocean front, T_f, were found on a temperature versus depth profile, obtained, e.g., with an XBT. From these depths a range of nutrient values could be measured by *in situ* sampling. The change in nutrients versus the change in temperature over the depth range, corresponding to $T_c - T_f$,

could be a first approximation of the slope, m, for a regression equation to predict nutrient concentrations within the surface feature. This slope approximation could be combined with the oceanic water surface temperature as described earlier to compute the nutrient (N) intercept, b, whereby the total regression equation, $N = mT + b$, can be formulated. The conditions for which this approximation would be best suited are those in which there were not thermal exchanges with the environment and changes in nutrient concentrations due to biological activity. Accuracy of the application to IR satellite data would depend on the extent of agreement between the surface temperature inferred from the satellite image and the actual surface temperature.

5. A Hindcast of Nitrate Concentration Using Data from the November 1979 Cruise

The November 1979 cruise station 2 vertical temperature profile showed the nitrate source depth range for 11.85°C, T_c, and 14.0°C, T_f, to be 40 to 14m respectively. The nitrate range between these depths was 11.7 to 3.9 µM. The slope for this line, therefore, was *ca.* -3.7. A second approximation correcting for wind mixing and thermal exchange with the atmosphere [James, 1966] used 13.2°C for T_f to generate a slope of *ca.* -3.1. The oceanic water surface temperature used to predict the N-intercept, $b = -mT$, was 15.50°C. From these few measurements, a predictive regression equation was formulated.

The predictive regression equation computed from 333 *in situ* measurements was compared with the equations developed using the slope derived from source water characteristics and the temperature of the ocean water used as the T-intercept. The nitrate concentrations for 11.85° and 14.0°C were computed.

The best fit linear regression (correlation, r = -0.93) based on underway *in situ* measurements was:

$$N = -3.24\,T + 47.74.$$

where N = μM nitrate and T = °C temperature. The predictive regression equation, assuming no thermal exchange with the environment, was:

$$N_1 = -3.7\,T + 57.35$$

The second approximation which corrected for wind mixing and atmospheric thermal exchange was:

$$N_2 = -3.1\,T + 48.05$$

a. Comparison of Predicted Nitrate Concentration to That Computed by Regression Analysis of Observed Data

The solution to the equations are as follows: for T_c of 11.85°C, N = 9.82 μM, N_1 = 13.5 μM, and N_2 = 11.3 μM nitrate; for T_f of 14.0°C, N = 2.94 μM, N_1 = 5.5 μM, and N_2 = 4.7 μM nitrate. The percentage of error ($\frac{N_1 - N}{N}$ x 100 and $\frac{N_2 - N}{N}$ x 100), associated in predicting the nitrate concentration at the cold center or most recently upwelled water appears to be *ca.* +37% for the first approximation,

N_1, and *ca.* +15% for N_2 which accounted for wind mixing and thermal exchange. In the vicinity of the ocean front, the percentage of error increased; for T_f of 14.0°C, N_1 had an error of *ca.* +98% whereas N_2 had an error of *ca.* +58%. In both hindcasts the nutrient concentrations predicted were higher than those computed from the equation based on *in situ* surface measurements. Both hindcasts also deteriorated in reliability proceeding away from the cold center of the feature. The predictive equation which corrected for wind mixing and thermal exchange with the atmosphere had significantly less error than the equation that did not. Because nitrate and temperature are nonconservative within the upper layer of the ocean, the 15% error derived from linear regression should be considered reasonable. In all, the longer the upwelled water is in contact with the surface layer of the ocean, the more complex the interactions with the physical and biological environment may become, and the more unrealistic the simple predictive equations.

b. Summary of Conditions for Which This Test Appeared Satisfactory

This hindcast was applied only to a shallow upwelling system which satellite history showed to be in an initial stage of development. The prediction was based on knowledge of the temperature of the sea surface within the coldest thermal pattern detected, surface temperature of the oceanic front detected by thermal patterns, a vertical

temperature and nutrient profile within the upper 200m of the ocean seaward of the oceanic front, and atmospheric parameters to hindcast ocean-atmosphere thermal exchange [James, 1966]. In this special case, given this limited ground truth, it was possible to hindcast within 15% error the maximum nutrient concentration in an upwelling system detected by satellite imagery. It therefore seems reasonable to assume that at least the major patterns of nutrient distributions can, with further research, be inferred using satellite imagery and limited ground truth (i.e., data from buoys and AXBT's).

V. CONCLUSIONS

1. Inference of nutrient distribution by satellite detected upwelling systems is feasible.

2. Active upwelling systems are expected to have strong inverse linear correlations between nutrients and temperature.

3. The nutrient front position can be approximated closely by the thermal oceanic front.

4. The nutrient distribution within a feature can not be related to the sharpness of the thermal front.

5. To predict nutrient distributions, ground truth as well as satellite detected thermal patterns are required.

6. A linear regression can be used to forecast nutrient maxima for upwelling systems in the initial stage of development aided by only limited *in situ* data.

7. The approximation of nutrient concentrations by linear regression can be improved by estimating the effects of wind mixing and thermal exchange with the atmosphere.

8. With greater knowledge of source water characteristics (from *in situ* monitoring or historical data), stage of development (inferred from satellite images and *in situ* monitoring), and dynamic processes (wind mixing, advection, and heat transfer) a forecast of nutrient distributions with a surface thermal feature could be made.

APPENDIX A

Listing of Surface Data: Time, Latitude, Longitude, Elapsed Distance, Nitrate, Phosphate, Nutrient Ratio, ATP, ΔATP/ATP, Chlorophyll, Temperature

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
0224	36 16.9	122 5.9	0.6	0.98				0.93	15.95
			1.2	0.93				0.92	16.05
			1.8	0.85				0.89	16.10
			2.4	0.77			247.0	0.89	16.15
			3.1	0.69				0.84	16.20
			3.7	0.49				0.78	16.20
			4.3	0.45				0.82	16.25
			4.9	0.45				0.74	16.30
			5.5	0.41				0.69	16.30
			6.1	0.45	0.56	0.8		0.68	16.25
			6.7	0.41	0.54	0.8		0.67	16.25
			7.3	0.45	0.53	0.8		0.66	16.25
			7.9	0.53	0.53	1.0		0.70	16.25
			8.6	0.61	0.53	1.2		0.66	16.20
			9.2	0.65	0.53	1.2		0.65	16.15
			9.8	0.65	0.53	1.3		0.64	16.15
			10.4	0.73	0.53	1.4		0.65	16.15
			11.0	0.77	0.53	1.5		0.64	16.15
			11.6	0.85	0.53	1.6	216.6	0.63	16.15
0300	36 11.1	122 6.0	12.1	0.93	0.54	1.7		0.62	16.10
			12.6	1.14	0.54	2.1		0.63	16.05
			13.0	1.34	0.56	2.4		0.64	15.90
			13.5	1.46	0.56	2.6		0.67	15.80
			14.0	1.50	0.56	2.7	190.2	0.64	15.75
			14.4	1.59	0.57	2.8		0.67	15.70
			14.9	1.79	0.58	3.1		0.65	15.60
			15.4					0.62	15.60
			15.8					0.61	15.55
			16.3	2.03	0.59	3.4	225.3	0.63	15.45
			16.8	2.17	0.67	3.1		0.61	15.45
			17.3	1.87	0.58	3.2		0.66	15.60
0323	36 6.1	122 6.2	17.9	1.87	0.57	3.3		0.64	15.70
			18.5	1.75	0.56	3.1		0.64	15.75
			19.2	1.50	0.54	2.8	225.3	0.62	15.80
			19.8	0.97	0.53	1.8		0.57	15.95
			20.5	0.93	0.51	1.8		0.59	15.95
			21.1	1.10	0.55	2.0		0.58	15.90
			21.7	1.38	0.57	2.4		0.60	15.85
			22.4	1.67	0.59	2.8	38.3	0.57	15.85
			23.0	1.71	0.59	2.9		0.57	15.90
			23.7					0.55	16.10
			24.3					0.49	16.30
			24.9					0.52	16.40
			25.6	--.--	0.51		97.6	0.50	16.55
			26.2	--.--	0.51			0.50	16.60
			26.9	--.--	0.50			0.47	16.60
			27.5	--.--	0.48			0.47	16.60
			28.2	--.--	0.53			0.45	16.60
			28.8	--.--	0.54		157.2	0.46	16.65
0400	36 1.7	122 6.0	29.4	--.--	0.53			0.44	16.65

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			30.0	--.--	0.54			0.44	16.60
			30.6	0.04	0.54	0.1		0.45	16.60
			31.2	0.12	0.54	0.2		0.45	16.60
			31.9	0.12	0.53	0.2	116.0	0.44	16.55
			32.5	0.16	0.53	0.3		0.44	16.55
			33.1	0.24	0.55	0.4		0.42	16.55
			33.7	0.28	0.54	0.5		0.42	16.55
			34.3	0.45	0.55	0.8		0.42	16.55
			34.9	0.49	0.55	0.9	186.3	0.42	16.60
			35.5	0.49	0.55	0.9		0.43	16.60
			36.1					0.43	15.55
			36.7	0.93	0.58	1.6		0.44	16.50
			37.4	1.22	0.60	2.0		0.45	16.45
			38.0	1.54	0.62	2.5	179.8	0.50	16.35
			38.6	1.87	0.64	2.9		0.50	16.20
			39.2	2.24	0.67	3.3		0.52	15.90
			39.8	2.60	0.68	3.8		0.55	15.85
			40.4	3.01	0.72	4.2		0.55	15.45
			41.0	2.81	0.68	4.1	179.7	0.53	15.35
			41.6	2.81	0.70	4.0		0.53	15.40
			42.2	2.81	0.75	3.7		0.52	15.40
			42.9	2.85	0.74	3.9		0.52	15.45
			43.5	2.85	0.74	3.9		0.46	15.45
			44.1	2.85	.75	3.8	159.7	0.48	15.45
			44.7	2.89	0.75	3.9		0.46	15.50
			45.3	2.93	0.76	3.9		0.45	15.55
			45.9	3.01	0.75	4.0		0.45	15.50
			46.5	3.05	0.74	4.1		0.44	15.45
			47.1	3.01	0.75	4.0	127.9	0.44	15.45
0500	35 51.8	122 6.0	47.8	3.05	0.75	4.1		0.44	15.40
			48.4	3.05	0.75	4.1		0.44	15.40
			49.0	3.13	0.75	4.2		0.45	15.35
			49.7	3.25	0.75	4.3		0.43	15.35
			50.3	3.38	0.77	4.4	53.4	0.42	15.35
			50.9	3.54	0.78	4.5		0.41	15.30
			51.5	3.58	0.79	4.5		0.42	15.30
			52.2	3.66	0.74	4.9		0.42	15.25
			52.8	3.74	0.75	5.0		0.42	15.15
			53.4				54.7	0.37	15.10
			54.1					0.35	15.20
			54.7	3.66	0.74	4.9		0.37	15.30
			55.3	3.74	0.75	5.0		0.38	15.25
			55.9	3.66	0.76	4.8		0.38	15.40
			56.6	3.46	0.75	4.6	140.0	0.36	15.50
			57.2	3.32	0.74	4.5		0.37	15.60
			57.8	3.09	0.71	4.4		0.37	15.70
			58.5	2.76	0.67	4.1		0.42	15.75
			59.1	2.36	0.67	3.5		0.50	15.80
			59.7	2.15	0.62	3.5	309.9	0.54	15.80
			60.4	2.07	0.62	3.3		0.52	15.80

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			61.0	2.07	0.61	3.4		0.50	15.85
			61.6	2.11	0.62	3.4		0.48	15.90
			62.2	2.23	0.62	3.7		0.44	15.95
			62.9	2.28	0.62	3.7	171.3	0.38	16.10
			63.5	2.21	0.64	3.4		0.38	16.15
			64.1	2.20	0.63	3.5		0.36	16.20
			64.8	2.24	0.63	3.6		0.36	16.20
			65.4	2.15	0.63	3.4		0.36	16.25
			66.0	2.07	0.63	3.3	209.2	0.36	16.25
0600	35 41.6	122 6.9	66.6	1.99	0.62	3.2		0.38	16.30
			67.2	1.14	0.56	2.0		0.38	16.30
			67.8	0.93	0.53	1.8		0.39	16.45
			68.3	0.93	0.53	1.8		0.41	16.50
			68.9	0.89	0.52	1.7	160.1	0.44	16.55
			69.5	0.89	0.50	1.8		0.44	16.60
			70.1	0.89	0.52	1.7		0.47	16.65
			70.7					0.47	16.70
			71.2					0.46	16.70
			71.8				231.0	0.47	16.75
			72.4					0.47	16.75
			73.0					0.47	16.75
			73.6					0.47	16.75
			74.1					0.47	16.70
			74.7					0.47	16.70
			75.3				275.7	0.49	16.70
			75.9					0.48	16.70
			76.5					0.46	16.65
			77.0					0.45	16.65
			77.6					0.44	16.60
			78.2				270.2	0.44	16.60
			78.8					0.44	16.60
			79.4					0.44	16.60
			79.9					0.44	16.55
			80.5					0.42	16.55
			81.1				349.0	0.42	16.55
			81.7					0.41	16.55
			82.3					0.41	16.55
			82.9					0.40	16.55
			83.4				142.0	0.38	16.55
0700	35 32.2	122 7.3	84.0					0.38	16.55
			84.6					0.38	16.55
			85.2					0.38	16.55
			85.8					0.39	16.55
			86.4					0.40	16.55
			87.0					0.43	16.55
			87.5					0.41	16.55
			88.1					0.42	16.55
			88.7					0.42	16.55
			89.3				358.0	0.43	16.55
			89.9					0.45	16.60

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			90.5					0.46	16.60
			91.1	--.--	0.49			0.46	16.60
			91.6	--.--	0.46			0.46	16.60
			92.2	--.--	0.44		254.3	0.47	16.65
0730	35 27.5	122 9.1	92.8	--.--	0.42			0.49	16.65
			93.3	0.01	0.45	0.0		0.50	16.60
			93.8	0.05	0.44	0.1		0.52	16.60
			94.3	0.05	0.43	0.1		0.54	16.60
			94.9	0.05	0.43	0.1	355.8	0.56	16.60
			95.4	0.05	0.43	0.1		0.57	16.60
			95.9	0.01	0.43	0.0		0.59	16.55
			96.4	0.01	0.43	0.0		0.60	16.50
			97.0	0.01	0.45	0.0		0.63	16.45
			97.5	0.01	0.45	0.0	350.4	0.64	16.45
			98.0	0.05	0.46	0.1		0.67	16.40
			98.5	0.09	0.43	0.2		0.68	16.40
			99.0	0.15	0.43	0.1		0.68	16.35
			99.6	0.19	0.44	0.2		0.68	16.35
			100.1	0.13	0.48	0.3	375.8	0.68	16.35
0800	35 31.0	122 5.1	100.6					0.68	16.35
			101.1					0.68	16.35
			101.7	0.13	0.46	0.3		0.66	16.35
			102.2	0.13	0.45	0.3		0.66	16.40
			102.7	0.17	0.47	0.4	380.1	0.65	16.40
			103.2	0.13	0.45	0.3		0.64	16.45
			103.7	0.21	0.46	0.5		0.64	16.50
			104.2	0.21	0.46	0.5		0.63	16.50
			104.8	0.21	0.47	0.4		0.62	16.55
			105.3	0.21	0.47	0.4	355.6	0.62	16.55
			105.8	0.25	0.46	0.6		0.61	16.55
			106.3	0.26	0.46	0.6		0.60	16.60
			106.8	0.30	0.47	0.6		0.62	16.60
			107.4	0.30	0.46	0.7		0.60	16.65
			107.9	0.30	0.47	0.6	408.3	0.56	16.60
			108.4	0.34	0.48	0.7		0.54	16.55
			108.9	0.38	0.48	0.8		0.52	16.55
			109.4	0.42	0.48	0.9		0.50	16.55
			110.0					0.47	16.50
			110.5				470.6	0.46	16.50
			111.0	0.42	0.49	0.9		0.44	16.50
			111.5	0.46	0.48	1.0		0.43	16.45
			112.0	0.46	0.48	1.0		0.43	16.45
			112.5	0.46	0.49	0.9		0.42	16.40
			113.1	0.46	0.49	0.9	287.0	0.43	16.40
			113.6	0.46	0.50	0.9		0.42	16.40
			114.1	0.46	0.49	0.9		0.40	16.40
			114.6	0.46	0.50	0.9		0.39	16.40
			115.1	0.50	0.48	1.0		0.38	16.40
			115.7	0.50	0.50	1.0	444.6	0.38	16.40
0900	35 38.2	121 59.7	116.2	0.50	0.48	1.0		0.40	16.40

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			116.7	0.55	0.49	1.1		0.40	16.40
			117.3					0.41	16.40
			117.9					0.42	16.40
			118.4				296.3	0.41	16.40
			118.9					0.40	16.40
			119.5					0.40	16.35
			120.0					0.40	16.35
			120.5					0.42	16.30
			121.1				342.1	0.44	16.30
			121.6					0.43	16.25
			122.2					0.43	16.30
			122.7	0.42	0.48	0.9		0.44	16.30
			123.3	0.42	0.47	0.9		0.44	16.35
			123.8	0.42	0.46	0.9	367.2	0.44	16.35
			124.3	0.42	0.46	0.9		0.45	16.40
			124.9	0.46	0.47	1.0		0.45	16.40
			125.4					0.44	16.40
			126.0					0.43	16.45
			126.5	0.42	0.46	0.9	285.8	0.44	16.50
			127.1	0.42	0.46	0.9		0.44	16.50
			127.6	0.42	0.46	0.9		0.44	16.55
			128.2	0.38	0.45	0.8		0.44	16.55
			128.7	0.34	0.44	0.8		0.44	16.50
			129.3	0.34	0.45	0.8	424.7	0.45	16.50
			129.8	0.34	0.44	0.8		0.46	16.50
			130.3	0.34	0.45	0.8		0.47	16.50
			130.9	0.34	0.45	0.8		0.48	16.50
			131.4	0.34	0.44	0.8		0.48	16.50
			132.0	0.34	0.44	0.8	333.7	0.48	16.50
1000	35 46.1	121 54.8	132.5	0.34	0.45	0.8		0.48	16.50
			133.1	0.34	0.44	0.8		0.47	16.50
			133.6	0.34	0.44	0.8		0.47	16.50
			134.2	0.34	0.45	0.8		0.47	16.50
			134.8	0.38	0.44	0.9	335.0	0.46	16.45
			135.3	0.33	0.45	0.8		0.46	16.40
			135.9					0.44	16.45
			136.4					0.47	16.50
			137.0					0.47	16.50
			137.6	1.02	0.59	1.7	347.2	0.45	16.50
			138.1	0.99	0.55	1.8		0.45	16.50
			138.7	0.99	0.54	1.8		0.46	16.50
			139.3	1.01	0.54	1.9		0.48	16.45
			139.8	1.05	0.56	1.9		0.48	16.45
			140.4	1.05	0.56	1.9	544.9	0.51	16.40
			140.9	1.02	0.55	1.9		0.51	16.50
			141.5	1.02	0.54	1.9		0.51	16.55
			142.1	1.05	0.53	2.0		0.52	16.50
			142.6	1.16	0.54	2.1		0.51	16.50
			143.2	1.02	0.52	2.0	363.6	0.50	16.50
			143.8	0.91	0.52	1.8		0.51	16.60

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			144.3	0.80	0.50	1.6		0.53	16.65
			144.9	0.74	0.50	1.5		0.53	16.65
			145.4	0.74	0.49	1.5		0.52	16.70
			146.0	0.71	0.49	1.4	426.8	0.53	16.70
			146.6	0.71	0.48	1.5		0.53	16.70
			147.1	0.69	0.47	1.5		0.54	16.70
			147.7					0.52	16.70
			148.2	0.13	0.47	0.3		0.50	16.70
			148.8	0.16	0.47	0.3		0.50	16.70
1100	35 54.4	121 50.2	149.3	0.19	0.47	0.4		0.49	16.70
			149.9	0.19	0.47	0.4		0.49	16.70
			150.4	0.19	0.46	0.4		0.50	16.70
			151.0	0.19	0.47	0.4		0.50	16.70
			151.5	0.19	0.47	0.4	314.8	0.51	16.70
			152.1	0.19	0.48	0.4		0.51	16.70
			152.6	0.19	0.47	0.4		0.52	16.70
			153.2	0.19	0.47	0.4		0.52	16.65
			153.7	0.19	0.47	0.4		0.55	16.65
			154.2	0.55			457.2	0.54	16.60
			154.8	0.55				0.54	16.60
			155.3	0.58				0.56	16.60
			155.9	0.58				0.58	16.60
			156.4	0.27				0.59	16.55
			157.0	0.27	0.33	0.8	447.0	0.59	16.50
			157.5	0.27	0.35	0.8		0.59	16.50
			158.0	0.27	0.35	0.8		0.60	16.50
			158.6	0.30	0.35	0.9		0.60	16.45
			159.1	0.30	0.35	0.9		0.60	16.45
			159.7	0.33	0.37	0.9	382.6	0.60	16.45
			160.2	0.33	0.37	0.9		0.62	15.45
			160.8	0.38	0.39	1.0		0.62	16.40
			161.3	0.41	0.38	1.1		0.65	16.40
			161.8	0.44	0.40	1.1		0.67	16.40
			162.4	0.49	0.40	1.2	453.4	0.67	16.35
			162.9	0.55	0.40	1.4		0.68	16.30
			163.5	0.69	0.41	1.7		0.70	16.25
			164.0	0.88	0.42	2.1		0.71	16.15
			164.6	1.05	0.43	2.4		0.72	16.10
			165.1	1.19	0.45	2.6	110.1	0.74	16.05
1200	36 2.3	121 45.3	165.7	1.38	0.46	3.0		0.74	15.95
			166.2					0.74	15.65
			166.8					0.74	15.75
			167.3	2.05	0.50	4.1		0.73	15.70
1208	36 3.5	121 44.4	167.9	1.88	0.50	3.8	194.1	0.73	15.70
			168.5	1.60	0.48	3.3		0.72	15.75
			169.0	1.43	0.47	3.0		0.72	15.80
			169.6	1.13	0.45	2.5		0.73	15.95
			170.2	0.88	0.45	2.0		0.70	16.05
			170.7	0.58	0.43	1.3	364.0	0.70	16.15
			171.3	0.49	0.42	1.2		0.69	16.25

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CPLISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			171.9	0.44	0.41	1.1		0.66	16.30
			172.4	0.41	0.42	1.0		0.67	16.35
			173.0	0.44	0.46	1.0		0.65	16.35
			173.6	0.41	0.42	1.0	225.5	0.66	16.35
			174.1	0.35	0.41	0.9		0.66	16.40
			174.7	0.35	0.41	0.9		0.66	16.40
			175.2	0.33	0.41	0.8		0.64	16.40
			175.8	0.31	0.41	0.7		0.62	16.40
			176.4	0.30	0.42	0.7	257.2	0.60	16.40
			177.0	0.33	0.41	0.8		0.61	16.40
			177.5	0.33	0.41	0.8		0.62	16.45
			178.1					0.59	16.45
			178.7					0.59	16.45
			179.3				422.9	0.58	16.40
			179.8					0.55	16.40
			180.4					0.55	16.40
			181.0					0.54	16.45
			181.5					0.54	16.45
			182.1				196.2	0.53	16.45
1300	36 0.1	121 53.3	182.7	0.33	0.45	0.7		0.51	16.50
			183.3	0.31	0.45	0.7		0.51	16.50
			183.9	0.30	0.46	0.7		0.49	16.45
			184.5	0.30	0.46	0.7		0.50	16.45
			185.1	0.33	0.46	0.7	344.3	0.51	16.45
			185.6	0.63				0.52	16.40
			186.2	0.63				0.51	16.40
			186.8	0.35	0.49	0.7		0.51	16.35
			187.4	0.38	0.53	0.7		0.50	16.35
			188.0	0.46	0.53	0.9		0.51	16.35
			188.6	0.49	0.59	0.8		0.51	16.35
			189.2	0.52	0.63	0.8		0.52	16.35
			189.8	0.52	0.65	0.8		0.54	16.30
			190.4	0.55	0.67	0.8		0.55	16.30
			191.0	0.60	0.66	0.9	335.1	0.55	16.30
			191.6	0.63	0.64	1.0		0.56	16.30
			192.2	0.69	0.64	1.1		0.56	16.35
			192.8	0.71	0.64	1.1		0.56	16.35
			193.4	0.80	0.64	1.2		0.57	16.35
			193.9	0.82	0.62	1.3	325.9	0.57	16.35
			194.5	0.83				0.56	16.35
			195.1	0.91	0.60	1.5		0.57	16.30
			195.7	0.88				0.57	16.30
			196.3	0.96	0.58	1.7		0.56	16.20
			196.9	1.13	0.58	1.9	273.9	0.56	16.20
			197.5	1.10	0.58	1.9		0.56	16.20
			198.1	1.24	0.56	2.2		0.56	16.15
			198.7	1.30	0.49	2.7		0.57	16.10
			199.3	1.43	0.49	2.9		0.60	16.00
			199.9	1.66	0.53	3.1	396.7	0.62	16.00
1400	35 54.9	122 3.2	200.5	1.93	0.55	3.5		0.63	15.80

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			200.9	2.25	0.57	4.0		0.64	15.55
			201.5	3.04	0.62	4.9		0.62	15.55
			202.2	2.68	0.61	4.4		0.63	15.55
			202.8	2.79	0.60	4.6	264.6	0.64	15.45
			203.4	3.15	0.64	4.9		0.62	15.40
			204.0	3.38	0.65	5.2		0.63	15.15
			204.6	3.63	0.66	5.5		0.62	15.15
			205.1	3.60	0.71	5.1		0.63	15.25
			205.7	3.54	0.65	5.4	152.3	0.62	15.30
			206.3	3.57	0.65	5.5		0.62	15.30
			206.9	3.60	0.64	5.6		0.62	15.20
			207.5	3.82	0.65	5.8		0.61	15.20
			208.1	3.68	0.65	5.7		0.63	15.20
			208.7	3.46	0.63	5.5	838.4	0.64	15.25
			209.3	3.40	0.62	5.5		0.64	15.25
			209.8	3.32	0.62	5.4		0.65	15.20
			210.4	3.35	0.62	5.4		0.66	15.20
			211.0	3.46	0.62	5.6		0.67	15.20
			211.6	3.65	0.64	5.7	59.5	0.67	15.10
			212.2	3.88	0.64	6.1		0.68	15.10
			212.9	3.96	0.66	6.0		0.71	15.20
			213.4	4.01	0.67	6.0		0.73	15.10
			213.9	3.90	0.65	6.0		0.76	15.10
			214.5	3.99	0.66	6.0	79.4	0.76	15.10
			215.1	3.99	0.65	6.1		0.77	15.15
			215.7	3.82	0.65	5.9		0.79	15.05
			216.3	3.74	0.63	5.9		0.79	15.00
			216.9	3.74	0.63	5.9		0.83	15.05
			217.5	3.69	0.65	5.7	266.9	0.87	15.00
1500	35 48.3	122 11.7	218.1	3.72	0.65	5.7		0.50	15.00
			218.6	3.75	0.65	5.8		0.38	14.95
			219.2	3.78	0.65	5.8		0.34	14.90
			219.8					0.33	14.65
			220.4	4.17	0.66	6.3	237.8	0.26	14.85
			221.0	4.21	0.70	6.2		0.26	14.80
			221.6	4.36	0.70	6.2		0.25	14.80
			222.2	4.31	0.70	6.2		0.31	14.85
			222.7	4.25	0.71	6.0		0.61	14.90
			223.3	4.11	0.70	5.9	135.5	0.60	14.90
			223.9	4.10	0.70	5.7		0.62	15.00
			224.5	3.83	0.69	5.6		0.60	15.05
			225.1	3.75	0.67	5.6		0.59	15.10
			225.7	3.75	0.68	5.5		0.57	15.15
			226.3	3.69	0.66	5.6	86.2	0.53	15.20
			226.8	3.55	0.66	5.4		0.52	15.25
			227.4	3.55	0.66	5.4		0.51	15.25
			228.0	3.55	0.65	5.5		0.50	15.25
			228.6	3.80	0.68	5.6		0.48	15.20
			229.2	3.75	0.67	5.6	128.8	0.47	15.20
			229.8	3.75	0.68	5.5		0.46	15.25

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			230.4	3.75	0.70	5.4		0.44	15.25
			231.0	3.86	0.70	5.5		0.42	15.35
			231.5	3.61	0.68	5.3		0.44	15.45
			232.1	3.41	0.67	5.1	116.4	0.44	15.50
			232.7	3.02	0.66	4.6		0.42	15.55
			233.3					0.42	15.60
			233.9					0.40	15.65
			234.5					0.41	15.65
			235.1				175.9	0.39	15.65
1600	35 42.2	122 20.9	235.6					0.34	15.65
			236.2					0.34	15.65
			236.8					0.34	15.65
			237.4					0.34	15.65
			237.9				158.9	0.35	15.65
			238.5	2.91	0.68	4.3		0.35	15.65
			239.1	2.88	0.65	4.4		0.35	15.65
			239.7	3.00	0.65	4.6		0.35	15.50
			240.2	3.11	0.64	4.9		0.35	15.45
			240.8	3.22	0.64	5.0	186.9	0.35	15.45
1620	35 40.4	122 28.5	241.4	3.36	0.65	5.2		0.33	15.45
			241.9	3.41	0.70	4.9		0.36	15.40
			242.5	3.44	0.70	4.9		0.35	15.40
			243.0	3.33				0.35	15.55
			243.6	2.85			50.6	0.36	15.80
			244.1	1.99				0.37	16.05
			244.7	1.46				0.36	16.25
			245.3	1.18				0.36	16.30
			245.9	1.12				0.38	16.35
			246.4	1.07			114.9	0.36	16.35
			246.9					0.36	16.40
			247.5					0.36	16.40
			248.0					0.40	16.45
			248.6					0.42	16.50
			249.1				269.8	0.42	16.55
			249.7					0.40	16.55
			250.2					0.40	16.60
			250.8					0.41	16.60
			251.4					0.43	16.65
			251.9				157.9	0.44	16.65
1700	35 39.3	122 16.4	252.5					0.41	16.70
			253.1					0.41	16.70
			253.6	0.44	0.49	0.9		0.42	16.70
			254.2	0.33	0.50	0.7		0.44	16.70
			254.8	0.33	0.49	0.7	306.7	0.43	16.70
			255.4	0.30	0.49	0.6		0.43	16.70
			255.9	0.28	0.49	0.6		0.43	16.70
			256.5	0.25	0.49	0.5		0.45	16.65
			257.1	0.25	0.49	0.5		0.46	16.65
			257.7	0.28	0.50	0.6	308.7	0.44	16.65
			258.2	0.28	0.50	0.6		0.46	16.65

TIM GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			258.8	0.30	0.51	0.6		0.45	16.60
			259.4	0.28	0.51	0.6		0.45	16.60
			259.9	0.28	0.50	0.6		0.47	16.55
			260.5	0.23	0.50	0.5	219.9	0.46	16.55
			261.1	0.28	0.47	0.6		0.46	16.55
			261.7	0.25	0.50	0.5		0.44	16.55
			262.2	0.25	0.49	0.5		0.46	16.55
			262.8	0.25	0.48	0.5		0.47	16.55
			263.4	0.25	0.48	0.5	504.8	0.47	16.55
			264.0	0.22	0.51	0.4		0.47	16.55
			264.5	0.22	0.51	0.4		0.48	16.60
			265.1	0.19	0.49	0.4		0.48	16.60
			265.7	0.19	0.48	0.4		0.48	16.55
			266.3	0.19	0.49	0.4	132.0	0.49	16.55
			266.8	0.22	0.49	0.4		0.53	16.55
			267.4	0.19	0.51	0.4		0.54	16.55
			268.0	0.19	0.51	0.4		0.52	16.50
			268.6	0.22	0.50	0.4		0.50	16.50
			269.1				268.0	0.52	16.55
1800	35 39.3	122 5.0	269.7					0.50	16.55
			270.3					0.50	16.55
			270.9					0.46	16.55
			271.5					0.46	16.55
			272.1				291.8	0.46	16.55
			272.7	0.28	0.44	0.6		0.46	16.55
			273.2	0.28	0.47	0.6		0.49	16.50
			273.8	0.33	0.47	0.7		0.51	16.50
			274.4	0.33	0.51	0.6		0.51	16.45
			275.0	0.30	0.51	0.6	210.8	0.52	16.45
			275.6	0.33	0.51	0.6		0.47	16.40
			276.2	0.33	0.54	0.6		0.52	16.35
			276.8	0.33	0.57	0.6		0.52	16.45
			277.3	0.30	0.59	0.5		0.55	16.45
			277.9	0.25	0.53	0.5	560.3	0.55	16.45
			278.5	0.25	0.49	0.5		0.48	16.45
			279.1	0.25	0.50	0.5		0.50	16.40
			279.7	0.30	0.51	0.6		0.52	16.35
			280.3	0.33	0.51	0.6		0.50	16.40
			280.9	0.30	0.51	0.6	361.6	0.53	16.45
			281.4	0.25	0.51	0.5		0.53	16.50
			282.0	0.19	0.52	0.4		0.51	16.50
			282.6	0.14	0.51	0.3		0.51	16.50
			283.2	0.19	0.51	0.4		0.51	16.55
			283.8	0.19	0.51	0.4	536.6	0.49	16.60
			284.4	0.19	0.51	0.4		0.49	16.65
			285.0	0.22	0.51	0.4		0.54	16.60
			285.6	0.19	0.52	0.4		0.52	16.60
			286.1	0.16	0.52	0.3		0.54	16.60
			286.7				604.2	0.55	16.65
1900	35 40.5	121 53.4	287.3					0.49	16.65

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			287.9	--.--	0.46			0.52	16.70
			288.5	--.--	0.48			0.54	16.65
			289.1	--.--	0.49			0.51	16.60
			289.7	--.--	0.49		691.3	0.51	16.65
			290.3	--.--	0.47			0.49	16.70
			290.9	--.--	0.48			0.53	16.75
			291.5	--.--	0.49			0.53	16.70
			292.1	--.--	0.49			0.53	16.65
			292.7	--.--	0.49		720.7	0.50	16.60
			293.3	--.--	0.49			0.50	16.60
			293.9	--.--	0.49			0.45	16.55
			294.5	--.--	0.49			0.52	16.50
			295.1	--.--	0.51			0.51	16.50
			295.7	--.--	0.48		211.4	0.47	16.40
			296.3	--.--	0.43			0.46	16.35
			296.9	--.--	0.37			0.48	16.30
			297.5					0.51	16.25
			298.1					0.53	16.30
			298.7	--.--	0.41		314.1	0.55	16.35
			299.3	--.--	0.44			0.61	16.40
			299.9	--.--	0.46			0.54	16.40
			300.5	--.--	0.48			0.54	16.45
			301.1	--.--	0.49			0.54	16.45
			301.7	--.--	0.47		305.1	0.51	16.50
			302.3	--.--	0.47			0.49	16.60
			302.9	--.--	0.49			0.49	16.60
			303.5	--.--	0.50			0.46	16.60
			304.1	--.--	0.51			0.45	16.60
			304.7	--.--	0.51		246.4	0.44	16.60
2000	35 42.8	121 41.8	305.3	--.--	0.53			0.48	16.60
			305.9	--.--	0.53			0.46	16.60
			306.4	--.--	0.54			0.51	16.60
			307.0	--.--	0.56			0.52	16.55
			307.6	--.--	0.54		257.3	0.54	16.55
			308.2	--.--	0.54			0.55	16.50
			308.8					0.54	16.45
			309.4	--.--	0.50			0.54	16.45
			310.0	--.--	0.53			0.54	16.40
			310.5	0.11	0.54	0.2	111.3	0.53	16.35
			311.1	0.30	0.56	0.5		0.52	16.20
			311.7	0.42	0.58	0.7		0.56	16.20
			312.3	0.58	0.60	1.0		0.57	16.05
			312.9	0.95	0.63	1.5		0.63	15.90
			313.5				386.5	0.64	15.80
2030	35 43.4	121 36.0	314.0	1.15				0.71	15.95
			314.6	1.75				0.76	16.10
			315.1	0.58	0.79	0.7		0.69	16.30
			315.7	0.33	0.60	0.5		0.67	16.30
			316.2	0.25	0.54	0.5	251.8	0.61	16.35
			316.7	0.25	0.52	0.5		0.58	16.30

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			317.2	0.28	0.49	0.6		0.58	16.35
			317.8					0.59	16.40
			318.4					0.64	16.40
			318.9				194.6	0.63	16.45
			319.5	0.05	0.35	0.1		0.62	16.45
			320.0	0.05	0.39	0.1		0.64	16.45
			320.5					0.60	16.45
			321.1					0.59	16.50
			321.6				269.1	0.60	16.55
2100	35 45.6	121 40.7	322.2					0.60	16.50
			322.8	0.05	0.39	0.1		0.58	16.55
			323.3	0.11	0.33	0.3		0.55	16.55
			323.9	0.05	0.36	0.1		0.58	16.55
			324.4	0.05	0.37	0.1	195.5	0.56	16.60
			325.0	0.05	0.37	0.1		0.55	16.60
			325.6	0.05	0.40	0.1		0.52	16.65
			326.1	0.08	0.39	0.2		0.52	16.70
			326.7	0.11	0.43	0.3		0.53	16.70
			327.2	0.08	0.39	0.2	304.2	0.50	16.70
			327.8	0.08	0.38	0.2		0.52	16.70
			328.4	0.11	0.38	0.3		0.55	16.75
			328.9	0.11	0.38	0.3		0.55	16.75
			329.5	0.11	0.38	0.3		0.55	16.75
			330.1				265.5	0.54	16.80
			330.6					0.54	16.80
			331.2					0.53	16.85
			331.7					0.52	16.90
			332.3	0.05	0.31	0.2		0.52	16.90
			332.9	0.08	0.33	0.2	298.9	0.50	16.95
			333.4	0.08	0.35	0.2		0.52	16.95
			334.0	0.08	0.35	0.2		0.52	17.00
			334.5	0.08	0.35	0.2		0.50	17.00
			335.1	0.08	0.37	0.2		0.49	17.05
			335.7	0.08	0.37	0.2	134.7	0.49	17.05
			336.2	0.08	0.37	0.2		0.49	17.05
			336.8	0.08	0.38	0.2		0.49	17.00
			337.4	0.14	0.38	0.4		0.49	17.00
			337.9	0.16	0.38	0.4		0.54	17.00
			338.5	0.28	0.40	0.7	158.7	0.53	17.00
2200	35 49.2	121 51.0	339.0	0.28	0.41	0.7		0.53	17.00
			339.6	0.33	0.41	0.8		0.50	17.00
			340.2	0.42	0.42	1.0		0.48	17.00
			340.8	0.39	0.43	0.9		0.49	16.90
			341.3	0.42	0.41	1.0	1287.5	0.46	16.85
			341.9					0.46	16.65
			342.5					0.45	16.90
			343.0	0.28	0.37	0.8		0.45	16.90
			343.6	0.42	0.46	1.0		0.44	16.90
			344.2	0.39	0.42	0.9	61.7	0.43	16.90
			344.7	0.42	0.41	1.0		0.43	16.90

R/V ACANIA 27 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			345.3	0.39	0.41	1.0		0.42	16.80
			345.9	0.36	0.42	0.9		0.44	16.80
			346.4	0.36	0.42	0.9		0.44	16.75
			347.0	0.33	0.41	0.8	191.8	0.44	16.75
			347.6	0.36	0.41	0.9		0.44	16.75
			348.1	0.37	0.42	0.9		0.45	16.80
			348.7	0.39	0.42	0.9		0.44	16.80
			349.3	0.39	0.42	0.9		0.46	16.75
			349.9	0.39	0.42	0.9	285.4	0.44	16.75
			350.4	0.39	0.42	0.9		0.46	16.75
			351.0	0.42	0.44	1.0		0.43	16.75
			351.5	0.50	0.45	1.1		0.42	16.75
			352.1					0.40	16.75
			352.7				122.0	0.39	16.75
			353.2	0.72	0.45	1.6		0.37	16.75
			353.8	0.84	0.48	1.8		0.36	16.70
			354.4	0.98	0.51	1.9		0.35	16.60
			354.9	1.29	0.51	2.5		0.34	16.50
			355.5	1.62	0.55	2.9	107.3	0.33	16.55
2300	35 52.1	122 1.8	356.1	1.59	0.55	2.9		0.36	16.55
			356.6	1.54	0.56	2.8		0.39	16.60
			357.2	1.51	0.56	2.7		0.41	16.50
			357.7	1.59	0.55	2.8		0.41	16.55
			358.3	1.59	0.54	2.9	299.8	0.40	16.50
			358.8	1.59	0.55	2.9		0.39	16.35
			359.4	1.79	0.60	3.0		0.45	16.20
			359.9	2.24	0.60	3.7		0.44	16.10
			360.5	2.43	0.61	4.0		0.37	16.00
			361.0	2.49	0.62	4.0	306.2	0.37	16.00
			361.6	2.66	0.64	4.2		0.37	15.85
			362.1	3.11	0.67	4.6		0.36	15.90
			362.7	3.11	0.67	4.6		0.32	15.90
			363.2	3.42	0.71	4.8		0.31	15.85
			363.8	3.36	0.70	4.8	221.5	0.31	15.60
			364.3	3.44	0.72	4.8		0.30	15.85
			364.9	3.50	0.72	4.9		0.29	15.85
			365.4	3.36	0.71	4.7		0.28	15.90
			366.0	3.05	0.68	4.5		0.28	15.95
			366.5	2.94	0.67	4.4	175.8	0.28	15.85
			367.1	2.88	0.66	4.4		0.27	15.90
			367.6	2.91	0.67	4.3		0.27	16.00
			368.2	2.94	0.66	4.5		0.26	15.80
			368.7	2.91	0.68	4.3		0.26	15.90
			369.3	2.91	0.69	4.2	180.5	0.31	15.95
			369.8	2.91	0.68	4.3		0.26	15.95
			370.3	2.72	0.66	4.1		0.25	16.05
			370.9	2.57	0.66	3.9		0.24	16.10
			371.4	2.49	0.65	3.8		0.26	16.00
			372.0	2.49	0.70	3.6	173.0	0.25	16.00
0000	35 55.1	122 12.2	372.5	2.38	0.64	3.7		0.24	16.05

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			373.0	2.21	0.66	3.3		0.22	16.20
			373.5	1.96	0.64	3.1		0.21	16.30
			374.0	1.76	0.73	2.4		0.20	16.40
			374.5	1.45	0.61	2.4	283.6	0.26	16.55
			375.0	1.17	0.58	2.0		0.24	16.70
			375.5	1.09	0.58	1.9		0.23	16.75
			375.9	0.92	0.54	1.7		0.24	16.75
			376.4	0.81	0.54	1.5		0.20	16.70
			376.9	0.75	0.54	1.4	352.3	0.18	16.70
			377.4	0.58	0.54	1.1		0.17	16.65
			377.9	0.56	0.54	1.0		0.17	16.65
			378.4	0.53	0.54	1.0		0.15	16.70
			378.9	0.42	0.53	0.8		0.14	16.70
			379.4				329.2	0.16	16.70
			379.9					0.13	16.70
			380.4					0.12	16.70
			380.9					0.11	16.70
			381.4					0.10	16.70
			381.9				349.6	0.09	16.65
			382.4					0.09	16.65
			382.9					0.08	16.65
			383.4					0.07	16.60
			383.8					0.07	16.20
			384.3				173.9	0.06	16.05
			384.8					0.06	16.00
			385.3					0.06	16.05
0053	35 57.8	122 21.5	386.0					0.05	16.45
			386.6					0.04	16.65
			387.3				299.8	0.04	16.70
0100	35 57.1	122 21.0	387.9					0.04	16.70
			388.6					0.04	16.70
			389.2					0.04	16.70
			389.9					0.05	16.70
			390.6				332.8	0.05	16.70
			391.2					0.06	16.70
			391.9					0.06	16.70
			392.6					0.07	16.70
			393.2					0.07	16.70
			393.9				216.0	0.07	16.70
			394.5					0.08	16.60
			395.2					0.08	16.50
			395.8					0.08	16.30
			396.5					0.09	15.85
			397.2		0.85		283.0	0.09	15.65
			397.9		0.79			0.10	15.60
			398.6		0.78			0.12	15.60
			399.2		0.74			0.13	15.65
			399.9		0.70			0.13	15.75
			400.6		0.67		295.3	0.14	15.80
			401.2		0.68			0.14	15.80

R/V ACANIA 28 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			401.9		0.64			0.14	15.80
			402.6		0.63			0.15	15.80
			403.2		0.61			0.16	15.75
			403.9		0.61		260.9	0.17	15.80
			404.5		0.63			0.15	15.75
			405.2		0.63			0.15	15.70
			405.9		0.65			0.16	15.65
			406.6		0.71			0.16	15.60
			407.2				277.3	0.16	15.35
0200	35 48.4	122 13.1	407.8					0.14	15.35
			408.5	--.--	0.72			0.14	15.35
			409.1	--.--	0.74			0.14	15.30
			409.7	--.--	0.77			0.14	15.30
			410.4	--.--	0.79		2989.9	0.12	15.50
			411.0	--.--	0.81			0.11	15.45
			411.6	--.--	0.85			0.10	15.25
			412.2	--.--	0.84			0.11	15.25
			412.9	--.--	0.96			0.10	15.65
			413.5	--.--	0.80		384.5	0.10	15.65
			414.1	--.--	0.76			0.09	15.70
			414.7	--.--	0.73			0.09	15.75
			415.3	--.--	0.72			0.08	15.70
			416.0	--.--	0.77			0.09	15.95
			416.6	--.--	0.72		1167.6	0.08	16.05
			417.2	--.--	0.66			0.09	16.10
			417.8					0.09	16.30
			418.5					0.06	16.45
			419.1					0.05	16.70
			419.7				169.2	0.05	16.65
			420.3					0.04	16.75
			421.0					0.05	16.80
			421.6					0.04	16.80
			422.2					0.04	16.80
			422.8				195.2	0.04	16.70
			423.5					0.04	16.80
			424.1					0.03	16.65
			424.7					0.03	16.70
			425.3					0.02	16.70
			425.9				297.1	0.02	16.70
0300	35 40.3	122 4.9	426.5					0.02	16.70
			427.1					0.02	16.70
			427.6					0.02	16.70
			428.1					0.02	16.70
			428.6				327.5	0.02	16.70
			429.2					0.02	16.70
			429.7					0.02	16.70
			430.2					0.02	16.75
			430.8					0.02	16.75
			431.3				1829.5	0.02	16.75
			431.9					0.03	16.75

R/V ACANIA 28 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			432.4					0.03	16.75
			432.9					0.03	16.75
			433.5					0.03	16.75
			434.0				355.8	0.03	16.75
			434.5					0.03	16.75
			435.1					0.03	16.70
			435.6					0.03	16.70
			436.1					0.03	16.70
			436.7				267.3	0.03	16.70
			437.2					0.03	16.70
			437.8					0.03	16.70
			438.3					0.03	16.70
			438.8					0.03	16.65
			439.4				362.0	0.03	16.65
			439.9					0.03	16.60
			440.4	0.44	0.47	0.9		0.03	16.60
			441.0	0.44	0.43	1.0		0.03	16.70
			441.5	0.47	0.42	1.1		0.03	16.60
			442.1	0.50	0.41	1.2	478.4	0.03	16.65
0400	35 34.8	121 57.0	442.6	0.53	0.39	1.4		0.03	16.60
			443.2	0.50	0.38	1.3		0.03	16.60
			443.8	0.56	0.37	1.5		0.03	16.60
			444.3	0.53	0.36	1.5		0.03	16.65
			444.9	0.47	0.37	1.3	350.5	0.03	16.65
			445.5	0.47	0.36	1.3		0.03	16.65
			446.0	0.53	0.37	1.4		0.03	16.60
			446.6	0.53	0.37	1.4		0.03	16.60
			447.2	0.56	0.38	1.5		0.03	16.55
			447.7	0.53	0.37	1.4	314.1	0.03	16.50
			448.3	0.50	0.35	1.4		0.03	16.50
			448.9	0.44	0.37	1.2		0.03	16.50
			449.4	0.42	0.40	1.0		0.03	16.50
			450.0					0.03	16.50
			450.6				324.8	0.03	16.50
			451.1					0.03	16.45
			451.7					0.03	16.45
			452.3					0.03	16.45
			452.8					0.03	16.45
			453.4				240.9	0.02	16.50
			454.0					0.02	16.45
			454.5					0.02	16.50
			455.1					0.02	16.40
			455.7					0.02	16.40
			456.2				315.8	0.02	16.45
			456.8					0.02	16.40
			457.4					0.02	16.40
			458.0					0.02	16.30
			458.5					0.02	16.30
			459.1				347.9	0.03	16.25
			459.7					0.02	16.25

R/V ACANIA 28 SEPTEMBER 1979 CHEMICAL MESOSCALE (CRUISE IX)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			460.2					0.02	16.25
			460.6					0.02	16.20
0505	35 28.[illegible]	121 44.0	461.2					0.03	16.20
			461.7				242.7	0.03	16.25
			462.2					0.03	16.20
			462.6					0.03	16.20
			463.1					0.03	16.25
			463.6					0.03	16.25
			464.0				583.7	0.03	16.25
			464.5					0.03	16.30
			465.0					0.03	16.30
			465.4					0.03	16.30
			465.9					0.03	16.40
			466.3				266.2	0.03	16.45
			466.8					0.04	16.50
			467.3					0.04	16.50
			467.7					0.04	16.50
			468.2					0.04	16.50
			468.7				325.7	0.03	16.50
			469.1					0.04	16.45
			469.6					0.04	16.45
			470.0					0.04	16.45
			470.5					0.04	16.45
			471.0				407.8	0.04	16.45
			471.4					0.04	16.45
			471.9					0.04	16.45
			472.4					0.04	16.45
			472.8					0.05	16.45
			473.3	--.--	0.27		500.1	0.04	16.40
0600	35 35.[illegible]	121 49.5	473.8	--.--	0.18			0.04	16.40
			474.4	--.--	0.14			0.04	16.45
			474.9	--.--	0.14			0.04	16.40
			475.5	--.--	0.12			0.04	16.40
			476.0	--.--	0.12		297.6	0.04	16.40
			476.6	--.--	0.12			0.04	16.35
			477.1	--.--	0.46			0.04	16.35
			477.7	--.--	0.45			0.04	16.35
			478.2	0.03	0.44	0.1		0.04	16.35
			478.8	--.--	0.43		543.5	0.03	16.35
			479.3	--.--	0.43			0.03	16.40
			479.9	--.--	0.41			0.03	16.40
			480.4	--.--	0.47			0.03	16.40
			481.0	--.--	0.40			0.03	16.45
			481.5	--.--	0.39		349.3	0.03	16.50
			482.1	--.--	0.41			0.03	16.50
			482.6	--.--	0.39			0.03	16.55
			483.2	--.--	0.40			0.03	16.60
			483.7	--.--	0.35			0.03	16.60
			484.3	--.--	0.35		514.1	0.02	16.65
			484.8	--.--	0.35			0.02	16.65

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			485.4	--.--	0.35			0.02	16.65
			485.9	--.--	0.36			0.02	16.70
			486.5	--.--	0.36			0.02	16.70
			487.0	--.--	0.37		770.2	0.02	16.70
			487.6	--.--	0.36			0.02	16.70
			488.1	--.--	0.36			0.02	16.70
			488.7	--.--	0.37			0.02	16.75
			489.2	--.--	0.37			0.02	16.75
			489.8	--.--	0.37		348.4	0.02	16.75
0700	35 43.6	121 52.2	490.4	--.--	0.37			0.02	16.75
			491.0	--.--	0.37			0.02	16.80
			491.6	--.--	0.37			0.02	16.75
			492.2	--.--	0.38			0.03	16.70
			492.8	--.--	0.38		421.5	0.03	16.70
			493.4	--.--				0.03	16.70
			494.0	--.--				0.04	16.75
			494.6	--.--				0.04	16.75
			495.2	--.--	0.33			0.04	16.80
			495.8	--.--	0.32		361.6	0.05	16.85
			496.4	--.--	0.31			0.05	16.85
			497.0	--.--	0.31			0.05	16.80
			497.6	--.--	0.32			0.05	16.80
			498.1	--.--				0.06	16.80
			498.7	--.--			305.0	0.06	16.80
			499.3	--.--				0.06	16.80
			499.9	--.--	0.54			0.06	16.80
			500.5	--.--	0.52			0.07	16.80
			501.1	--.--	0.52			0.07	16.80
			501.7	0.13	0.51	0.1	451.1	0.08	16.80
			502.3	--.--	0.49			0.08	16.80
			502.9	--.--	0.50			0.08	16.75
			503.5	--.--	0.52			0.09	16.75
			504.1	--.--	0.52			0.09	16.70
			504.7						

R/V ACANIA 29 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
0142	36 6.5	121 56.5	0.6						
			1.2						
			1.8						
			2.4						
			3.0				399.0		
			3.6						
			4.1						
			4.7						
			5.3						
0200	36 3.8	121 55.5	5.9				285.0		
			6.5						
			7.1						
			7.7						
			8.3						
			8.9				424.0		
			9.5	0.17					
			10.1	0.22					
			10.7	0.22					
			11.3	0.22					
			11.9	0.13			577.0		15.40
			12.4	0.13					15.50
			13.0	--.--					15.50
			13.6	--.--					15.40
			14.2	--.--					15.40
			14.8	--.--			441.0		15.35
			15.4	--.--					15.40
			16.0	0.17					15.30
			16.6	0.22					15.35
			17.2	--.--					15.40
			17.8	--.--			519.0		15.35
			18.4	--.--					15.35
			19.0	--.--					15.40
			19.6	--.--					15.35
			20.1	--.--					15.45
			20.7	--.--			434.0		15.40
			21.3	--.--					15.30
			21.9	--.--					15.25
0255	35 56.4	121 50.6	22.5	--.--					15.30
			23.1	--.--					15.30
			23.7	--.--			435.0		15.35
			24.3	--.--					15.20
			24.9	0.22					15.10
			25.4	0.31					15.10
			26.0						15.10
			26.6				669.0		15.10
			27.2						15.05
			27.8						15.05
			28.4	0.72					15.15
			29.0	0.81					15.15
			29.6	0.49			468.0		15.10

R/V ACANIA 29 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			30.1	0.40					15.10
			30.7	0.31					15.15
			31.3	0.27					15.00
			31.9	0.17					15.20
			32.5				429.0		15.15
			33.1						15.15
			33.7						15.15
			34.2						15.15
			34.8						15.15
			35.4				358.0		15.10
			36.0						15.15
			36.6						15.15
			37.2						15.20
			37.8						15.40
			38.3				374.0		15.00
			38.9						15.15
			39.5						15.15
			40.1						15.20
			40.7						15.20
			41.3				366.0		15.15
			41.9						15.25
			42.5						15.20
0405	36 0.4	121 37.9	43.0						15.15
			43.6						15.15
			44.2				415.0		15.15
			44.8						15.15
			45.4						15.15
			46.0						15.15
			46.6						15.15
			47.1				432.0		15.15
			47.7						15.15
			48.3						15.15
			48.9						15.15
			49.5						15.15
			50.1				335.0		15.15
			50.7						15.20
			51.3						15.20
			51.8						15.20
			52.4						15.20
			53.0				353.0		15.15
			53.6						15.15
			54.2						15.15
			54.8						15.15
			55.4						15.15
			55.9				286.0		15.15
			56.5						15.15
			57.1						15.15
			57.7						15.20
			58.3						15.20
0500	36 7.3	121 45.3	58.7				434.0		15.15

R/V ACANIA 29 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			59.1						15.15
			59.5						15.10
			60.0						15.10
			60.4						15.10
			60.8				362.0		15.15
			61.2						15.10
			61.6						15.15
			62.1						15.10
			62.5						14.90
			62.9				420.0		14.90
			63.3						14.70
			63.7						14.35
			64.2						14.25
			64.6						14.35
			65.0				322.0		14.25
			65.4						14.15
			65.8						14.20
0535	36 10.8	121 49.1	66.3						14.25
0538	36 11.1	121 48.7	66.7						14.35
			67.1				445.0		14.50
			67.5						14.65
			67.9						14.45
0545	36 9.9	121 48.2	68.4						14.35
			68.8						14.40
			69.2				477.0		14.75
			69.6						14.90
			70.0						14.90
0555	36 9.3	121 49.4	70.5						14.80
			71.2						14.40
			71.8				532.0		14.45
			72.4						14.30
			73.0						14.25
			73.6						14.15
0608	36 10.9	121 51.8	74.2						14.05
			74.8				454.0		14.10
			75.4						14.00
			76.0						14.00
			76.6						14.10
			77.2						14.15
			77.8				479.0		14.00
0622	36 12.3	121 48.6	78.4						13.80
			78.9						13.95
			79.4						14.15
			80.0						14.20
			80.5				463.0		14.30
			81.0						14.45
			81.6						14.55
			82.1						14.60
			82.7						14.45
			83.2				524.0		14.45

R/V ACANIA 29 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			83.7						14.70
			84.3						14.80
0645	36 9.7	121 46.0	84.8						14.85
			85.6						14.85
			86.3				335.0		14.95
			86.9						15.15
			87.6						15.10
			88.2						15.10
			88.9						15.05
			89.6				481.0		14.90
			90.2						14.55
0703	36 7.8	121 49.2	90.7						14.80
			91.2						14.80
			91.7						14.80
			92.2				377.0		14.75
			92.7						14.60
			93.2						14.50
			93.7						14.40
			94.2						14.30
			94.7				419.0		14.60
			95.2						14.85
			95.7						14.80
			96.2						14.80
			96.7						14.75
			97.2						14.70
			97.7				362.0		14.70
0734	36 11.0	121 52.5	98.4						14.70
			99.1						14.70
			99.9						14.70
			100.6				452.0		14.75
			101.3						14.30
			102.0						13.40
			102.7						13.90
0747	36 12.7	121 50.2	103.2						13.55
			103.8				388.0		13.55
0752	36 13.2	121 50.8	104.3						13.75
			104.8						13.30
			105.3						13.00
			105.8						13.60
0800	36 12.7	121 51.5	106.5				338.0		14.25
			107.2						14.60
			107.9						14.65
			108.5						14.65
			109.2						14.65
			109.9				430.0		14.65
			110.6						14.50
			111.2						14.50
			111.9						14.50
0817	36 11.5	121 54.2	112.6						14.50
			113.2				243.0		14.50

R/V ACANIA 29 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NH3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			113.9						14.50
			114.6						14.50
			115.2						14.55
			115.9						14.55
			116.6				382.0		14.65
			117.2						14.75
			117.9						14.85
			118.6						14.95
			119.2						14.95
			119.9				432.0		15.00
			120.6						14.95
			121.2						14.80
			121.9						14.65
			122.6						14.65
			123.2				497.0		14.65
			123.9						14.60
			124.6						14.45
0855	36 5.5	121 49.8	125.2						14.45
			125.8						14.55
			126.5				417.0		14.65
0902	36 4.8	121 50.4	127.0						14.75
			127.6						14.70
			128.2						14.65
			128.8						14.65
			129.4				490.0		14.70
			130.0						14.85
			130.6						15.10
			131.1	0.32					15.10
			131.7	0.24					15.05
			132.3	0.24			434.0		14.95
			132.9	0.20					14.90
			133.5	0.16					14.75
			134.1	0.16					14.60
			134.7	0.20					14.60
			135.2	0.28			318.0		14.55
			135.8	0.32					14.50
			136.4	0.32					14.50
			137.0	0.44					14.50
			137.6	0.56					14.50
			138.2	0.60			353.0		14.45
			138.8	0.76					14.45
			139.4	0.84					14.40
			139.9	0.76					14.40
			140.5	0.68					14.40
			141.1	0.68			229.0		14.40
			141.7	0.68					14.40
			142.3	0.84					14.40
			142.9	0.88					14.35
0957	36 11.1	121 57.8	143.4	0.80					14.30
			143.9	0.92			337.0		14.30

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			144.5	1.10					14.30
			145.0	1.20					14.30
			145.5	1.24					14.25
			146.1	1.44					14.20
			146.6	1.40			454.0		14.20
			147.1	1.04					14.20
			147.7	0.64					14.30
			148.2						14.35
			148.7						14.35
			149.2				267.0		14.40
			149.8	0.64					14.45
			150.3	0.95					14.40
			150.8	1.12					14.35
			151.4	1.44					14.20
1029	36 14.3	121 53.7	152.0	3.37			364.0		13.35
			152.6	5.30					13.20
			153.1	4.08					13.45
			153.7	2.09					14.20
			154.3	1.68					14.25
			154.9	1.40			213.0		14.25
			155.5	1.44					14.25
			156.1	1.40					14.25
			156.7	1.40					14.25
			157.3	1.44					14.20
			157.9	1.28			114.0		14.15
			158.5	1.24					14.15
			159.1	1.32					14.15
			159.7	1.40					14.15
			160.3						14.00
			160.9				102.0		13.95
			161.4						13.90
			162.0						13.80
			162.6						13.60
			163.2	5.18					13.35
1110	36 17.7	121 59.8	163.8	5.70			125.0		13.15
			164.4	4.22					13.20
			165.0	4.26					13.35
			165.6	5.18					13.00
			166.2	5.26					13.00
			166.8	7.19			175.0		12.60
			167.4	7.23					12.60
			168.0	7.15					12.60
			168.6	6.63					12.75
			169.1	5.90					12.90
1130	36 21.3	121 59.6	169.7	6.79			219.0		12.60
			170.3	6.75					12.70
			170.9	6.79					12.60
			171.5	9.28					12.10
			172.1	9.92					11.95
			172.7	8.47			285.0		12.15

R/V ACANIA   29 NOVEMBER 1979   CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			173.3	7.39					12.35
			173.9	6.55					12.45
			174.5	5.86					12.55
			175.1	5.62					12.60
1149	36 21.9	122 2.8	175.6	5.34			234.0		12.65
			176.2	4.86					12.75
			176.8	4.86					12.70
			177.4	4.82					12.70
			177.9	5.14					12.65
			178.5	5.10			393.0		12.65
			179.1	5.50					12.60
			179.7	5.82					12.60
			180.2	6.02					12.55
			180.8						12.55
			181.4				205.0		12.50
			182.0						12.25
			182.5						12.15
			183.1						12.10
			183.7						11.85
			184.3				115.0		13.00
			184.8						13.20
			185.4						13.30
			186.0						13.25
			186.6						13.25
			187.1				159.0		13.25
			187.7						13.20
			188.3						13.15
			188.9	6.43					12.95
			189.4	6.31					12.95
			190.0	6.43			52.0		12.85
			190.6	6.83					12.80
			191.1	6.95					12.70
			191.7	7.83					12.45
			192.3	8.43					12.35
			192.9	8.47			213.0		12.35
			193.4	8.67					12.25
			194.0	8.76					12.35
			194.6	8.27					12.45
			195.2	5.98					13.65
			195.7	3.05			57.0		14.05
			196.3	2.09					14.20
			196.9	1.12					14.55
1305	36 10.2	122 4.4	197.5	0.48					14.65
			198.0	0.20					14.70
			198.6	0.16			189.0		14.70
			199.2	0.12					14.70
			199.8	0.16					14.70
1315	36 10.0	122 3.0	200.4	0.20					14.70
			200.9	0.24					14.75
			201.5	0.44			161.0		14.60

R/V ACANIA 29 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			202.1	0.92					14.35
			202.7	2.01					14.10
			203.3	4.01					13.95
			203.9	3.37					13.45
			204.5	6.22			215.0		13.35
			205.1						12.90
			205.7	5.78					12.90
			206.3	6.18					12.95
			206.9	5.71					12.90
			207.5	6.35			155.0		12.90
			208.1	6.55					12.75
			208.7	6.83					12.65
			209.3	6.96					12.60
			209.8	7.16					12.60
			210.4	7.21			148.0		12.55
			211.0	7.28					12.50
			211.6	7.43					12.50
			212.2	7.52					12.50
			212.8	7.64					12.45
1400	36 16.3	122 5.6	213.4	7.76			207.0		12.40
			214.0	8.00					12.35
			214.6	8.13					12.30
			215.2	8.17					12.30
			215.8	7.96					12.30
			216.4	7.88			173.0		12.25
			216.9	7.32					12.20
			217.5	7.16					12.30
1415	36 18.7	122 5.4	218.2	6.75					12.35
			218.9	6.43					12.45
			219.5	6.19			173.0		12.50
			220.2	5.99					12.50
			220.8	5.99					12.55
			221.5						12.55
			222.1						12.60
1430	36 16.8	122 8.7	222.7				204.0		12.70
			223.3						12.70
			[illegible]						12.70
			224.4						12.65
			225.0	6.03					12.55
			225.6	6.31			187.0		12.65
			226.2	6.23					12.80
			226.8	6.15					12.90
			227.3	5.99					13.00
			227.9	5.95					13.10
			228.5	5.63			11.0		13.15
			229.1	5.71					13.20
			229.7	5.54					13.30
			230.2	5.30					13.30
			230.8	4.98					14.00
			231.4	4.74			149.0		14.00

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			232.0	4.58					14.10
			232.6	4.17					14.10
			233.1	2.00					14.40
			233.7	1.96					14.60
			234.3	1.84			169.0		14.70
			234.9	1.55					14.70
			235.5	1.55					14.70
			236.0	0.79					14.75
			236.6	0.38					14.80
			237.2	0.27			127.0		14.80
			237.8	0.23					14.80
			238.4	0.25					14.80
			238.9	0.23					14.80
			239.5						14.75
			240.1				241.0		14.70
			240.7						14.60
			241.3						14.55
			241.9						14.50
			242.4						14.50
			243.0				152.0		14.50
1542	36 7.6	122 9.9	243.6						14.50
			243.9	0.59					14.40
			244.3	0.59					14.40
			244.7	0.67					14.25
			245.1	0.71			172.0		14.25
			245.6	0.75					14.30
			246.0	0.99					14.30
1555	36 7.9	122 11.7	246.6	1.03					14.30
			247.1	0.87					14.35
			247.7	0.67			177.0		14.40
			248.3	0.63					14.40
			248.9	0.55					14.45
			249.4	0.47					14.55
			250.0	0.39					14.65
			250.6	0.27			224.0		14.70
			251.2	0.27					14.75
			251.7	0.27					14.75
			252.3	0.23					14.75
			252.9	0.27					14.75
			253.5	0.27			169.0		14.70
			254.0	0.35					14.65
			254.6	0.43					14.65
			255.2	0.55					14.60
			255.8	0.83					14.55
			256.3	1.27			134.0		14.40
			256.9	2.19					14.00
			257.5	2.59					13.90
			258.0	2.47					13.90
			258.6						13.80
			259.2				179.0		13.15

R/V ACANIA 29 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			259.8						13.15
			260.3						13.00
			260.9						13.00
			261.5						13.00
			262.1				163.0		12.95
			262.6						13.00
			263.2						12.95
			263.8						12.85
			264.4						13.00
			264.9				142.0		12.75
			265.5						12.70
			266.1						12.70
			266.7						12.75
			267.2	4.56					12.80
			267.8	4.60			161.0		12.85
			268.4	4.56					12.90
			269.0	3.76					13.00
			269.5	3.60					13.10
			270.1	3.00					13.20
			270.7	2.71			115.0		13.30
			271.2	1.79					13.45
			271.8	1.65					13.70
			272.4	1.31					13.80
			273.0	0.95					14.00
			273.5	0.79			170.0		14.10
			274.1	0.79					14.20
1733	36 23.0	122 0.3	274.7	0.75					14.15
			275.3	0.59					14.10
			275.9	0.79					14.00
			276.5	0.87			119.0		13.90
			277.1						13.75
			277.7						13.60
			278.3						13.50
			278.9						13.40
			279.5				193.0		13.25
			280.1						13.15
			280.6						13.10
			281.2						13.05
			281.8						12.90
			282.4				143.0		12.85
			283.0						12.85
			283.6						12.80
			284.2						12.75
			284.8						12.75
			285.4				128.0		12.70
			286.0						12.60
			286.6						12.50
			287.2	4.20					12.30
			287.7	5.65					12.10
			288.3				112.0		12.05

R/V ACANIA 29 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			288.9						12.05
			289.5	6.51					12.05
			290.1	5.26					12.10
			290.7	4.59					12.20
			291.3	4.76			112.0		12.65
			291.9						12.80
			292.5						13.20
			293.1	1.12					13.25
			293.7	1.13					13.95
1840	36 13.8	122 3.8	294.3	1.92			121.0		13.90
			294.9						13.90
1843	36 13.5	122 4.4	295.5	2.55					13.80
			296.0						13.80
1847	36 14.1	122 5.5	296.6						13.40
			297.2				77.0		13.30
			297.8						13.40
			298.3						14.05
1855	36 14.6	122 4.1	298.8						14.05
			299.3						14.05
			299.8				120.0		13.85
			300.2						13.30
			300.7						13.05
			301.2						12.50
			301.7						12.35
			302.1				125.0		12.45
1912	36 12.7	122 2.8	302.8						12.40
			303.4						12.25
			304.0						12.45
			304.7						12.45
			305.3				139.0		12.60
			306.0						12.60
1923	36 11.6	122 4.7	306.5						12.65
			307.1						12.85
			307.7						12.95
			308.3				114.0		13.25
			308.9						13.25
			309.4						13.50
			310.0						13.55
			310.5						13.35
			311.1				128.0		13.20
			311.7						13.00
1943	36 13.9	122 7.3	312.2						12.70
			312.8						12.80
			313.3						12.90
			313.8				65.0		13.30
			314.4						13.40
			314.9	1.80					14.20
			315.5	1.16					14.20
			316.0	1.12					14.20
			316.5	1.16			79.0		14.30

R/V ACANIA   29 NOVEMBER 1979   CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
2002	36 15.2	122 4.8	216.5	1.20					14.35
			216.5	1.24					14.35
			216.5	1.24					14.30
			216.5	1.21					14.30
			216.5	1.20					14.30
			216.5	1.16					14.30
			216.5	1.23					14.30
			216.5	1.24					14.30
			216.5	1.28					14.30
			216.5	1.28					14.30
			216.5	1.32					14.30
			216.5	1.32					14.30
			216.5	1.40					14.30
			216.5	1.40					14.30
			216.5	1.44					14.30
			216.5	1.44					14.30
			216.5	1.48					14.30
			216.5	1.48					14.30
			216.5	1.40					14.30
			216.5	1.44					14.20
			216.5	1.48					14.20
			216.5	1.56					13.90
2045	36 15.8	122 4.8	217.0	2.20					13.50
			217.4	4.01					13.10
			217.9				22.0		12.90
			218.4						12.90
			218.8						13.10
			219.3						13.20
			219.7						13.55
			220.2				106.0		13.60
			220.6						13.65
			221.1						13.90
			221.6						14.00
			222.0						14.15
			222.5				53.0		14.30
			222.9						14.50
			223.4						14.55
			223.8						14.70
			224.3						14.85
			224.7				62.0		14.85
			225.2						14.85
			225.7	0.88					14.95
			226.1	1.04					14.80
			226.6	0.80					14.90
			227.0	0.72			85.0		15.15
			227.5	0.80					15.05
2134	36 11.4	121 59.7	227.5	0.84					14.90
			227.5	0.80					14.80
			227.5	0.76					14.90
			227.5	0.80					14.80

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			227.5	0.76					14.80
			227.5	0.76					14.80
			227.5	0.76					14.80
			227.5	0.80					14.80
			227.5				57.0		14.75
			227.5						14.75
			227.5						14.70
			227.5						14.70
			227.5						14.70
			227.5						14.65
			227.5						14.65
			227.5						14.65
			227.5						14.60
			227.5						14.60
2210	36 11.4	121 59.7	227.8						14.60
			228.1						14.50
			228.5	0.80					14.60
			228.8	0.83					14.70
			229.1	0.81					14.80
			229.5	1.52			77.0		14.75
			229.8	1.43					14.75
			230.1						14.55
			230.4						14.55
			230.8						14.55
			231.1				126.0		14.85
			231.4						14.70
			231.7						14.20
			232.1						13.30
			232.4						12.90
			232.7						12.75
2241	36 12.1	122 3.0	232.7	6.69					12.80
			232.7	6.85					12.85
			232.7	6.65					12.95
			232.7	6.61					13.00
			232.7	6.57			165.0		13.05
			232.7	6.41					13.10
			232.7	6.21					13.15
			232.7	6.09					13.20
			232.7	5.57					13.20
			232.7	5.49					13.20
			232.7						13.25
			232.7						13.25
			232.7						13.50
			232.7						13.85
2310	36 12.1	122 3.0	233.2						13.50
			233.6						13.00
			234.1						12.80
			234.5	6.13					12.60
			235.0	7.18					12.50
			235.4	7.78					12.40

R/V ACANIA 29-30 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			235.9	8.02					12.65
			236.3	7.53					12.80
			236.8	6.81					12.90
			237.2	6.57					12.95
			237.7	6.17			139.0		13.10
			238.1						13.10
			238.6						13.10
			239.0						13.20
			239.5						13.30
			239.9				74.0		13.30
			240.4						13.20
2343	36 12.0	122 8.0	240.4						13.70
			240.4						13.65
			240.4						13.70
			240.4	3.28			65.0		13.65
			240.4	3.44					13.65
			240.4	3.64					13.65
			240.4	3.89					13.50
			240.4	3.64					13.55
			240.4	3.44					13.65
			240.4	3.36					13.65
			240.4	3.28					13.70
			240.4						13.70
			240.4						13.70
			240.4						13.70
0012	36 12.0	122 8.0	240.9						13.55
			241.4	3.28					13.40
			241.9	4.05					13.10
			242.5	5.41					13.25
			243.0	5.57			122.0		13.35
			243.5	5.41					13.35
			244.0	5.19					13.45
			244.5	4.77					13.45
			245.0						13.40
			245.6				104.0		13.20
			246.1						13.20
			246.5						13.25
			247.1						13.45
			247.5						13.10
			248.2				7.0		12.80
			248.7						13.00
0044	36 16.2	122 9.9	248.7						12.90
			248.7						12.90
			248.7	5.17					12.90
			248.7	5.21			99.0		12.90
			248.7	5.33					12.90
			248.7	5.33					12.90
			248.7	5.25					12.90
			248.7	5.17					12.90
			248.7				7.0		12.90

R/V ACANIA 30 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

TIM GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			348.7						12.90
			348.7						12.90
			348.7						12.90
			348.7						12.90
0110	36 16.2	122 9.9	349.2						12.90
			349.8						12.80
			350.3						12.80
			350.8						12.85
			351.4						12.95
			351.9				145.0		13.00
			352.4						13.05
			353.0						13.10
			353.5						13.15
			354.0						13.20
			354.6				108.0		13.15
			355.1						13.05
			355.7						13.10
0136	36 19.1	122 12.9	355.7						13.20
			355.7	3.48					13.25
			355.7	3.27			157.0		13.25
			355.7	3.40					13.20
			355.7						13.20
			355.7	3.69					13.20
			355.7	3.68					13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.20
			355.7						13.15
0215	36 19.1	122 12.9	356.2						13.10
			357.0						13.05
			357.6						12.95
			358.3						12.80
			358.9						12.80
			359.5						12.85
			360.2						12.80
			360.8						12.75
			361.5						12.80
			362.1						12.80
			362.8						12.70
			363.4						12.60
			364.1						12.55

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	CHL A MG/M3	TEMP DEG C
			264.7						12.50
			265.4						12.50
			266.0						12.50
			266.7						12.50
			267.3						12.50
			268.0						12.50
			268.6						12.50
			269.3						12.50
			269.9						12.50
0300	36 22.0	122 3.8	269.9						12.50
			269.9						12.45
			269.9						12.40
			269.9						12.40
			269.9						12.40
			269.9						12.40
			269.9						12.40
			269.9						12.55
			269.9						12.70
			269.9	7.05					12.75
			269.9	7.05					12.75
			269.9	7.[illegible]					12.75
			269.9	7.09					12.75
			269.9	7.18					12.70
			269.9	7.18					12.70
0330	36 22.0	122 3.8	270.5	7.36					12.70
			271.1	7.40					12.70
			271.7	7.36					12.70
			272.3	7.75					12.70
			272.9	7.44					12.65
			273.4	7.16					12.60
			274.0	6.87					12.50
			274.6	6.65					12.50
			275.2	6.25					12.55
			275.8						12.60
			276.4						12.70
			277.0						12.75
			277.5						12.95
			278.1						12.45
			278.7						12.55
			279.3						12.60
			279.9						12.80
			280.5						13.00
			281.1						13.10
			281.6						13.20
			282.2						13.15
			282.8						13.25
			283.4						13.15
			284.0						13.15
			284.6						13.30
			285.2						13.25

474.....END JOB HAN21916.....END JOB HAN21916.....END JOB HAN21916.....END JOB HAN21916.....END JOB HAN21916.....END JOB HAN21916...

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XI)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			0.6	4.00	1.35	3.0	285.0	0.34		12.35
			1.2	3.95	1.35	2.9				12.77
			1.9	4.10	1.35	3.0				12.69
			2.5	4.24	1.35	3.1				12.04
			3.1	4.44	1.36	3.3				12.57
0300	36 18.0	122 11.7	3.7	4.73	1.36	3.5	48.0	0.09	0.49	12.54
			4.2	4.83	1.38	3.5			0.43	12.44
			4.8	5.07	1.40	3.6			0.52	12.42
			5.4	4.73					0.57	12.33
			6.0	5.35	1.51	3.9			0.71	12.33
			6.6	5.80	1.48	3.9	328.0	0.16	0.72	12.37
			7.1	5.95	1.47	4.0			0.63	12.43
			7.7	6.05	1.47	4.1			0.68	12.37
			8.3	6.29	1.50	4.2			0.68	12.21
			8.9	6.58	1.48	4.4			0.73	12.17
			9.5	6.97	1.50	4.6	241.0	0.24	0.73	12.09
			10.1	7.27	1.55	4.7			0.83	11.97
			10.6	7.51	1.56	4.8			0.98	11.20
			11.2	8.05	1.57	5.1			1.07	11.56
			11.8	8.43	1.60	5.3			1.08	11.42
0330	36 13.6	122 9.5	12.3	8.78	1.63	5.4	258.0	0.25	1.19	11.51
			12.8	8.43	1.62	5.2			1.20	11.42
			13.3	8.73	1.63	5.4			0.93	11.10
			13.9	9.80	1.70	5.8			0.75	11.00
			14.4	10.73	1.77	6.1			0.66	11.00
			14.9	11.06	1.78	6.2	168.0	0.17	0.67	10.97
			15.4	11.31	1.80	6.3			0.82	10.91
			15.9	11.61	1.84	6.3				10.55
			16.5	12.39	1.85	6.7			1.03	10.42
			17.0	13.02	1.90	6.9			1.28	10.39
			17.5	13.46	1.93	7.0	380.0	0.22	1.54	10.42
			18.0	13.17	1.96	6.7			2.16	10.45
			18.5	11.51	1.82	6.3				10.55
			19.1	10.24	1.75	5.9			2.40	10.75
			19.6	9.35	1.71	5.6				10.95
0400	36 9.7	122 7.4	20.2	9.17	1.72	5.3	1164.0	0.19	2.52	10.90
			20.8	9.12	1.66	5.5			2.67	10.95
			21.5						2.85	10.77
			22.1						2.98	10.93
			22.7						2.98	10.84
			23.3	8.00			1549.0	0.16	3.08	10.85
			24.0	8.05	1.57	5.1			3.10	10.32
			24.6	8.14	1.59	5.1			3.04	10.77
			25.2	8.24	1.62	5.1			2.82	10.72
			25.9	8.48	1.64	5.2			2.71	10.70
			26.5	8.68	1.65	5.3	931.0	0.33	2.63	10.69
			27.1	8.87					2.54	10.57
			27.8	9.26	1.69	5.5			1.88	10.65
			28.4	9.61					1.31	10.63
			29.0	10.19	1.75	5.8			2.13	10.51

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	$\frac{\Delta ATP}{ATP}$	CHL A MG/M3	TEMP DEG C
0430	36 5.3	122 4.3	29.6	11.12	1.79	6.2	596.0	0.23	2.12	10.54
			30.1	10.82	1.76	6.1				10.53
			30.7	10.63	1.77	6.0			1.59	10.51
			31.2	10.73	1.79	6.0			1.30	10.54
			31.8	11.61	1.83	6.3			1.25	10.52
			32.3	12.09	1.85	6.5	731.0	0.25	1.14	10.70
			32.9	12.04	1.85	6.5			1.15	10.93
			33.5	11.51	1.82	6.3			1.16	11.30
			34.0	10.24	1.73	5.9			1.23	11.35
			34.6	9.95	1.72	5.8			1.17	11.38
			35.1	9.85	1.70	5.8	521.0	0.26	1.12	11.39
			35.7	9.56	1.68	5.7			0.94	11.45
			36.2	9.31	1.67	5.6			0.94	11.65
			36.8	8.53	1.63	5.2			0.95	11.80
			37.3	7.66	1.59	4.8			0.95	11.88
0500	36 1.5	122 1.3	37.9	7.02	1.53	4.6	347.0	0.33	0.95	11.93
			38.5	6.92	1.52	4.6			0.88	12.04
			39.1	6.92	1.53	4.5			0.81	12.05
			39.7						0.74	12.25
			40.2						0.73	12.32
			40.8				229.0	0.20	0.73	12.35
			41.4	4.44					0.72	12.42
			42.0	4.39	1.38	3.2			0.71	12.44
			42.6	4.14	1.36	3.0			0.71	12.45
			43.2	3.95	1.36	2.9			0.70	12.53
			43.7	3.80	1.35	2.8	214.0	0.26	0.75	12.50
			44.3	3.61	1.35	2.7			0.69	12.61
			44.9	3.56	1.35	2.6			0.68	12.63
			45.5	3.56	1.34	2.7			0.62	12.63
			46.1	3.71	1.35	2.7			0.61	12.53
0530	35 57.6	121 58.1	46.6	3.75	1.34	2.3	157.0	0.31	0.61	12.63
			47.2	3.56	1.32	2.7			0.60	13.00
			47.8	2.78	1.28	2.2			0.54	13.13
			48.4	2.58	1.29	2.0			0.54	12.92
			49.0	2.24					0.59	12.75
			49.5	2.78	1.30	2.1	175.0	0.35	0.58	12.94
			50.1	2.58	1.30	2.0			0.58	13.10
			50.7	2.24					0.55	13.16
			51.3	2.29	1.26	1.8			0.56	13.24
			51.9	2.10	1.25	1.7			0.51	13.33
			52.4	1.61			121.0	0.33	0.50	13.37
			53.0	2.10	1.28	1.6			0.55	13.46
			53.6	2.00					0.59	13.50
			54.2	2.00					0.59	13.43
			54.8	1.95					0.53	13.40
0600	35 53.6	121 55.2	55.3	1.95	1.24	1.6	58.0	0.24	0.58	13.44
			55.9						0.53	13.47
			56.5						0.53	13.49
			57.1						0.53	13.52
			57.7		0.95				0.52	13.52

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			58.2		0.95		122.0	0.32	0.52	13.53
			58.8		0.94				0.57	13.77
			59.4		0.91				0.51	13.59
			60.0		0.91				0.51	13.55
			60.6	0.29	0.95	0.3			0.51	13.53
			61.1	0.49	0.96	0.5	86.0	0.06	0.51	13.52
			61.7	0.83	0.98	0.8			0.50	13.54
			62.3	1.02	0.97	1.1			0.55	13.57
			62.9	1.07	0.99	1.1			0.54	13.50
			63.5	0.93	0.98	0.9			0.54	13.51
0612	35 51.9	121 54.0	63.6	0.83	0.99	0.8	173.0	0.47	0.54	13.48
			63.7	0.73	0.97	0.8			0.49	13.49
			63.9	0.88	1.00	0.9			0.52	13.48
			64.0	1.07	0.99	1.1			0.53	13.46
			64.2	0.93	0.99	0.9			0.48	13.47
			64.3	0.73	0.99	0.7	152.0	0.33	0.49	13.47
			64.5	0.68	0.99	0.7			0.52	13.46
			64.6	1.27	1.04	1.2			0.52	13.42
			64.7	1.17	1.02	1.1			0.47	13.42
			64.9	0.93	1.02	0.9			0.47	13.44
			65.0	0.78	1.00	0.8	319.0	0.27	0.47	13.46
			65.2	0.68	1.00	0.7			0.46	13.46
			65.3	0.63	1.00	0.6			0.45	13.44
			65.4	0.88	1.02	0.9			0.46	13.32
			65.6	1.12	1.06	1.1			0.45	13.46
0700	35 53.0	121 56.5	65.8	1.80	1.09	1.7	183.0	0.28	0.45	13.52
			65.9	2.10	1.09	1.9			0.45	13.53
			66.1	2.16	1.12	1.9			0.45	13.54
			66.2	2.30	1.11	2.1			0.45	13.52
			66.4	2.30	1.11	2.1			0.45	13.51
			66.6	2.30			135.0	0.46	0.45	13.50
			66.7						0.45	13.47
			66.9						0.45	13.43
			67.0						0.45	13.43
			67.2						0.45	13.40
			67.4				226.0	0.23	0.45	13.39
			67.5						0.45	13.42
			67.7	2.30	1.15	2.0			0.45	13.34
			67.8	2.35	1.15	2.0			0.45	13.34
			68.0	2.30	1.13	2.0			0.45	13.30
			68.2	2.35	1.14	2.1	129.0	0.23	0.45	13.28
			68.3	2.29	1.13	2.0			0.45	13.26
0734	35 53.9	121 57.5	68.4	2.35	1.13	2.1			0.45	13.27
			68.6	2.35	1.11	2.1			0.45	13.25
			68.7	2.35	1.12	2.1			0.45	13.24
			68.8	2.35	1.12	2.1	166.0	0.17	0.45	13.23
			68.9	2.40	1.13	2.1			0.45	13.21
			69.1	2.40	1.13	2.1			0.45	13.20
			69.2	2.40	1.13	2.1			0.45	13.20
			69.3	2.40	1.13	2.1			0.45	13.20

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			69.4	2.40	1.14	2.1	236.0	0.23	0.45	13.20
			69.6	2.40	1.12	2.1			0.45	13.13
			69.7	2.40	1.14	2.1			0.45	13.16
			69.8	2.40	1.10	2.2			0.45	13.17
			69.9	2.35	1.10	2.1			0.45	13.18
0800	35 54.7	121 58.3	70.1	2.30	1.10	2.1	152.0	0.30	0.45	13.20
			70.2	2.30	1.11	2.1			0.45	13.21
			70.3	2.30	1.11	2.1			0.44	13.20
			70.5	2.35	1.14	2.1			0.44	13.20
			70.6	2.35	1.13	2.1			0.43	13.14
			70.7	2.35	1.13	2.1	156.0	0.35	0.43	13.17
			70.9	2.40	1.14	2.1			0.42	13.15
			71.0	2.40	1.12	2.1			0.42	13.14
			71.1	2.40	1.12	2.1			0.42	13.13
			71.3	2.40	1.08	2.2			0.41	13.17
			71.4	2.35	1.09	2.2	221.0	0.30	0.41	13.16
			71.6	2.35	1.10	2.1			0.44	13.15
			71.7	2.40	1.10	2.2			0.44	13.14
			71.8	2.40	1.11	2.2			0.43	13.16
			72.0	2.40	1.11	2.2			0.43	13.17
0830	35 55.6	121 59.1	72.1	2.30	1.13	2.0	126.0	0.30	0.42	13.21
			72.2	2.30	1.11	2.1			0.42	13.21
			72.4	2.25	1.11	2.0			0.41	13.22
			72.5	2.25	1.10	2.0			0.41	13.22
			72.6	2.20	1.09	2.0			0.40	13.22
			72.8	2.20	1.11	2.0	157.0	0.31	0.40	13.23
			72.9	2.25	1.11	2.0			0.39	13.23
			73.0	2.25	1.08	2.1			0.39	13.24
			73.2	2.25	1.09	2.1			0.33	13.25
			73.3	2.30	1.10	2.1			0.38	13.24
			73.5	2.30	1.10	2.1			0.37	13.25
			73.6	2.25	1.12	2.0			0.37	13.25
			73.7	2.30	1.11	2.1			0.36	13.21
			73.9	2.30	1.12	2.1			0.36	13.20
			74.0	2.30	1.12	2.1			0.36	13.20
0900	35 56.4	122 0.0	74.1	2.30	1.12	2.1	121.0	0.19	0.36	13.17
			74.3	2.35	1.13	2.1			0.33	13.19
			74.4	2.40					0.34	13.17
			74.5	2.40	1.13	2.1			0.34	13.16
			74.7	2.40	1.15	2.1			0.38	13.12
			74.8	2.64	1.16	2.3			0.39	13.10
			74.9	2.74	1.18	2.3			0.39	13.04
			75.1						0.36	13.02
			75.2						0.40	12.97
			75.4						0.41	12.93
			75.5				155.0	0.16	0.41	12.90
			75.6						0.42	12.89
			75.8						0.42	12.89
			75.9						0.43	12.86
			76.0						0.43	12.85

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			76.2						0.47	12.32
			76.3						0.44	12.31
			76.4						0.45	12.30
0936	35 57.4	122 1.1	76.6						0.49	12.79
			76.7						0.50	12.78
			76.8				179.0	0.27	0.50	12.69
			76.9						0.51	12.72
			77.1						0.51	12.73
			77.2						0.52	12.72
			77.3						0.52	12.75
			77.4						0.53	12.71
			77.6						0.54	12.70
			77.7						0.54	[illegible]
			77.8						0.55	12.65
			77.9	3.37	1.37	2.5			0.55	12.53
1000	35 57.9	122 1.9	78.0	3.68	1.35	2.7	148.0	0.29	0.60	12.50
			78.2	3.83	1.35	2.8			0.61	12.41
			78.3	4.03	1.35	3.0			0.62	12.37
			78.4	4.13	1.35	3.1			0.58	12.39
			78.5	4.29	1.37	3.1			0.59	12.11
			78.7	4.69	1.39	3.4			0.60	12.52
			78.8	5.05	1.39	3.6			0.60	12.40
			78.9	5.15	1.39	3.7			0.61	[illegible]
			79.0	5.51	1.40	3.9			0.62	12.27
			79.2	5.56	1.41	3.9			0.63	12.35
			79.3	5.56	1.43	3.9	233.0	0.30	0.63	12.34
			79.4	5.66	1.43	4.0			0.74	12.32
			79.5	5.61	1.43	3.9			0.75	12.29
			79.7	6.02	1.45	4.2			0.76	12.21
			79.8	6.53	1.48	4.4			0.87	12.15
1030	35 58.6	122 2.8	79.9	6.93	1.53	4.5			0.83	12.15
			80.1	7.13	1.53	4.7			0.84	11.92
			80.2	8.15	1.58	5.2			0.85	11.93
			80.4	8.00	1.55	5.2			0.85	11.92
			80.5	7.95	1.57	5.1			0.86	11.92
			80.7	7.90	1.54	5.1	169.0	0.31	0.87	11.93
			80.9	7.90	1.56	5.1			0.88	11.93
			81.0	7.80	1.55	5.0			0.89	11.92
			81.2	7.84	1.54	5.1			0.90	11.91
			81.3	7.85	1.54	5.1			0.91	11.90
			81.5	7.74	1.54	5.0			0.92	11.91
			81.6	7.79	1.52	5.1			0.93	11.97
			81.8	7.79	1.52	5.1			0.94	11.95
			81.9	7.74	1.52	5.1			0.95	11.96
			82.1	7.69	1.53	5.0			0.95	11.97
			82.2	7.64	1.53	5.0	147.0	0.27	0.77	11.99
1102	35 59.4	122 4.1	82.4	7.59	1.52	5.0			0.77	12.00
			82.6	7.69	1.52	5.1			0.77	11.99
			82.7	7.69	1.52	5.1			0.77	11.97
			82.9	7.69	1.54	5.0			0.95	12.00

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			83.0	7.69	1.51	5.1			0.77	12.02
			83.2	7.64	1.48	5.2			0.77	12.03
			83.3	7.59	1.52	5.0			0.77	12.03
			83.5	7.54	1.54	4.9			0.77	12.03
			83.6	7.40	1.52	4.9			0.77	12.03
			83.8	7.44	1.53	4.9	288.0	0.32	0.77	12.04
			83.9	7.44	1.53	4.9			0.77	12.05
			84.1	7.39	1.52	4.9			0.77	12.06
			84.3	7.44	1.52	4.9			0.77	12.08
1128	35 0.1	122 5.1	84.4	7.39	1.52	4.9			0.77	12.05
			84.5	7.44	1.52	4.9	322.0	0.29	0.77	12.04
			84.7	7.49	1.52	4.9			0.71	12.03
			84.8	7.54	1.51	5.0			0.71	12.01
			85.0	7.49	1.52	4.9			0.71	12.00
			85.1	7.34	1.51	4.9			0.71	11.99
			85.3	7.44	1.52	4.9	203.0	0.22	0.71	11.99
			85.4	7.49	1.52	4.9			0.71	12.00
			85.6	7.29	1.51	4.8			0.71	12.01
			85.7	7.29	1.50	4.9			0.71	12.02
			85.9	7.29	1.50	4.9			0.71	12.05
			86.0	7.29	1.50	4.9			0.71	12.05
			86.2	7.29	1.49	4.9			0.71	12.10
			86.3	7.29	1.51	4.8			0.71	12.13
			86.5	7.24	1.50	4.8			0.71	12.12
			86.6	7.13	1.51	4.7			0.70	12.12
1200	36 1.0	122 6.1	86.8				275.0	0.37	0.72	12.12
			87.0						0.73	12.10
			87.3						0.74	12.10
			87.5						0.75	12.09
			87.7						0.76	12.07
			87.9						0.70	12.06
			88.1						0.78	12.07
			88.3						0.79	12.06
			88.5						0.73	12.07
			88.7						0.74	12.07
			88.9				215.0	0.33	0.82	12.05
			89.1						0.83	12.02
			89.4	6.93	1.55	4.5			0.77	12.01
			89.6	6.98	1.52	4.6			0.92	12.00
			89.8	6.98	1.51	4.6			0.85	12.00
1230	36 2.5	122 7.3	90.0	6.98	1.51	4.6			0.87	12.00
			90.2	6.93	1.51	4.6			0.88	12.00
			90.4	6.93	1.50	4.6			0.89	12.01
			90.6	6.88	1.49	4.6			0.90	12.01
			90.8	6.83	1.49	4.6			0.91	12.01
			91.0	6.88	1.51	4.6	169.0	0.29	0.85	12.01
			91.2	6.88	1.50	4.6			0.86	11.99
			91.4	6.88	1.52	4.5			1.02	11.97
			91.5	7.03	1.53	4.6			1.12	11.92
			91.7	7.18	1.55	4.6			1.13	11.92

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	$\frac{\Delta ATP}{ATP}$	CHL A MG/M3	TEMP DEG C
			91.9	7.03	1.54	4.6			1.22	11.93
			92.1	7.03	1.55	4.5			1.32	11.95
			92.3	7.08	1.54	4.6			1.42	11.95
			92.5	7.03	1.55	4.5			1.43	11.97
			92.7	6.52					1.44	11.98
1300	36 3.8	122 8.4	92.9				270.0	0.37	1.44	11.99
			93.2						1.34	12.00
			93.4						1.33	12.00
			93.6	6.78	1.43	4.7			1.41	12.00
			93.8	6.88	1.49	4.6			1.40	12.01
			94.0	6.93	1.46	4.7			1.39	12.00
			94.2	6.93	1.46	4.7			1.38	11.99
			94.5	7.08	1.45	4.9			1.37	11.94
			94.7	7.08	1.47	4.8			1.36	11.90
			94.9	7.24	1.45	5.0			1.35	11.87
			95.1	7.18	1.47	4.9	435.0	0.38	1.34	11.85
			95.3	7.29	1.47	5.0			1.25	11.82
			95.5	7.39	1.48	5.0			1.24	11.81
			95.8	7.44	1.51	4.9			1.23	11.80
			96.0	7.54	1.49	5.1			1.22	11.77
1330	36 5.2	122 9.7	96.2	7.64	1.52	5.0			1.14	11.73
			96.4	7.74	1.52	5.1			1.13	11.72
			96.7	7.90	1.53	5.2			1.12	11.70
			96.9	8.00	1.55	5.2			1.11	11.68
			97.1	8.15	1.54	5.3			1.10	11.62
			97.4	8.66	1.59	5.4	272.0	0.41	1.02	11.52
			97.6	9.78	1.65	5.9			0.94	11.30
			97.9	9.88	1.66	6.0			0.86	11.28
			98.1	10.03	1.66	6.0			0.86	11.18
			98.3	10.34	1.66	6.2			0.85	11.16
			98.6	10.29	1.66	6.2			0.84	11.12
			98.8	10.49	1.68	6.2			0.84	11.03
			99.0	10.39	1.68	6.2			0.90	11.10
			99.3	10.44	1.67	6.3			0.89	11.07
			99.5	10.54	1.71	6.2			0.95	11.03
1400	36 6.7	122 11.2	99.7				315.0	0.35		11.09
			99.9							11.06
			100.2							11.09
			100.4							11.07
			100.6							11.09
			100.8							11.10
			101.0	10.23	1.74	5.9				11.04
			101.3	10.39	1.77	5.9				11.00
			101.5	10.54	1.76	6.0				11.03
			101.7	10.64	1.75	6.1				11.00
			101.9	10.59	1.76	6.0	308.0	0.34		11.03
			102.2	10.64	1.75	6.1				11.03
			102.4	10.54	1.74	6.1				11.02
			102.6	10.54	1.74	6.1				11.06
			102.8	10.49	1.77	5.9				11.08

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
1430	36 3.0	122 12.7	103.1	10.39	1.76	5.9				11.00
			103.3	10.34	1.75	5.9				11.10
			103.6	10.23	1.75	5.8				11.10
			103.9	10.23	1.76	5.8				11.01
			104.1	10.18	1.76	5.8				10.99
			104.4	10.29	1.76	5.8				10.96
			104.6	10.29	1.75	5.9				10.96
			104.9	9.98	1.72	5.8				11.10
			105.2	9.57	1.62	5.9				11.30
			105.4	9.01	1.61	5.6				11.30
			105.7	8.81	1.57	5.6				11.31
			105.9	8.96	1.57	5.7				11.34
			106.2	8.86	1.57	5.6				11.39
			106.5	8.66	1.56	5.6				11.40
			106.7	8.56	1.54	5.6				11.46
1500	36 9.4	122 14.7	107.1	8.30	1.53	5.4	250.0	0.42		11.49
			107.4	8.52	1.53	5.6				11.50
			107.8	8.20	1.53	5.4				11.50
			108.1	8.10	1.51	5.4				11.49
			108.5	7.95						11.45
			108.8	8.05						11.53
			109.2	7.49						11.40
			109.5	8.10						11.49
			109.9	8.25						11.54
			110.2	7.95	1.50	5.3				11.34
			110.6	8.30	1.54	5.4	91.0	0.41		11.40
			110.9	8.10	1.50	5.4				11.42
			111.3	8.20	1.53	5.4				11.31
			111.6	8.20	1.56	5.3				11.36
			112.0	8.25	1.55	5.3				11.20
			112.3	8.66	1.59	5.4	232.0	0.37		10.36
			112.7	9.73	1.66	5.9				10.35
			113.0	9.57	1.65	5.8				10.32
			113.4	9.93	1.68	5.9				10.30
			113.8	9.93	1.70	5.8				10.79
			114.1	10.34	1.71	6.0				10.76
			114.5	10.29	1.74	5.9				10.70
			114.8	10.49	1.73	6.1				10.53
			115.2	10.59	1.73	6.1	223.0	0.60		10.55
			115.5	10.95	1.76	6.2				10.50
			115.9	11.45	1.78	6.4				10.37
			116.2	11.86	1.79	6.6				10.42
			116.6	11.71	1.79	6.5				10.46
			116.9	10.79	1.79	6.0				10.43
			117.3	11.61	1.78	6.5				10.49
			117.6	11.66	1.31	6.4	235.0	0.39		10.42
			118.0	10.44						10.65
			118.3	9.83	1.68	5.9				10.72
			118.7	9.22	1.65	5.6				10.74
			119.0	8.61						10.76

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			119.4	8.35	1.61	5.2				10.74
1612	36 7.3	122 6.6	119.9	8.46	1.59	5.3				10.70
			120.3	8.00	1.59	5.0				10.59
			120.8				547.0	0.42		10.54
			121.3							10.5[illegible]
			121.7							10.59
			122.2							10.59
			122.7							10.50
			123.1							10.5[illegible]
			123.6							10.67
1630	36 6.9	122 3.9	124.0				599.0	0.16		10.70
			124.4							10.73
			124.8	8.05	1.57	5.1				10.82
			125.2	8.81	1.65	5.3				10.92
			125.6	8.66						11.00
			126.0	8.30			250.0	0.37		11.06
			126.4	9.12						11.0[illegible]
			126.8	9.17						11.14
			127.2	9.47	1.62	5.8				11.15
			127.6	9.68	1.62	6.0				11.16
			128.0	10.08	1.63	6.2				11.17
			128.4	10.13	1.63	6.2				11.19
			128.8	10.18	1.65	6.2				11.17
			129.2	9.88	1.65	6.0				11.17
			129.6	10.23	1.66	6.2				11.15
1700	36 6.6	121 59.9	130.1	10.18	1.66	6.1	313.0	0.22		11.15
			130.5	10.39	1.66	6.3				11.12
			131.0	10.54	1.69	6.2				11.10
			131.4							11.0[illegible]
			131.9	10.79	1.71	6.3				11.04
			132.3	11.10	1.72	6.5				10.97
			132.8	11.25	1.74	6.5				10.95
			133.2	11.45	1.74	6.6				10.93
			133.7	11.35	1.73	6.6	280.0	0.35		11.02
			134.1	11.00	1.72	6.4				11.00
			134.6							10.94
			135.0	9.78	1.63	6.0				10.97
			135.5	9.73						10.85
			135.9		1.71					10.85
			136.4	10.69	1.68	6.4				10.85
1730	36 6.2	121 55.4	136.8	11.15	1.70	6.6	279.0	0.31		10.81
			137.3	10.90	1.71	6.4				10.80
			137.8	8.71						10.77
			138.2	10.90	1.72	6.3				10.6[illegible]
			138.7						1.00	10.62
			139.2	10.74	1.73	6.2			0.92	10.60
			139.6	10.95	1.70	6.4			0.91	10.51
			140.1	11.91	1.78	6.7			0.89	10.54
			140.6	11.71	1.75	6.7	338.0	0.28	1.01	10.45
			141.0						1.00	10.32

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	$\frac{\Delta ATP}{ATP}$	CHL A MG/M3	TEMP DEG C
			141.5	11.15					1.17	10.30
			141.9						1.21	10.23
			142.4						1.26	10.20
			142.9	12.52	1.77	7.1			1.36	10.15
			143.3	13.44	1.81	7.4			1.40	10.03
			143.8	13.94	1.88	7.4	291.0	0.34	1.32	10.04
1802	36 5.4	121 50.7	144.2	13.84	1.90	7.3			1.02	10.00
			144.7	14.00	1.96	7.5			0.95	9.74
			145.2						0.88	9.70
			145.6	16.49	2.22	7.4			0.81	9.26
			146.1	17.56	2.18	8.1	184.0	0.34	0.64	9.39
			146.5	17.76	2.16	8.2			0.63	9.47
			147.0	17.91	2.18	8.2			0.62	9.55
			147.4	17.50	1.97	8.9			0.61	9.62
			147.9	16.54	2.11	7.8			0.60	9.63
			148.4	16.49	2.10	7.9	239.0	0.30	0.59	9.54
			148.8						0.58	9.54
			149.3	16.08	2.08	7.7			0.57	9.70
			149.7	15.89	2.11	7.5			0.56	9.55
1828	36 4.9	121 46.6	150.1	16.08	2.13	7.5			0.46	9.50
			150.4	15.57	2.01	7.7	146.0	0.33	0.36	9.53
			150.7	15.27	2.02	7.6			0.35	9.65
			151.0						0.34	9.66
			151.3	16.02	2.10	7.6			0.38	9.72
1838	36 4.8	121 45.6	151.7	16.13	2.07	7.8			0.33	9.73
			152.0	16.08	2.05	7.8	133.0	0.42	0.33	9.30
			152.3	15.93	2.05	7.8			0.32	9.40
			152.6	15.93	2.02	7.9			0.31	9.30
			152.9	15.78	2.02	7.8			0.31	9.31
			153.3	15.72	2.02	7.8			0.30	9.32
			153.6	15.67	2.03	7.7	205.0	0.29	0.29	9.34
			153.9	15.78	2.04	7.7			0.29	9.55
			154.2	15.57	2.07	7.5			0.28	9.35
			154.5	16.80	2.15	7.9			0.31	9.37
			154.9	17.05	2.15	7.9			0.30	9.93
			155.2	16.89	2.16	7.8	198.0	0.53	0.29	9.35
			155.5	16.94	2.18	7.8			0.32	9.88
			155.8	17.71	2.24	7.9			0.37	9.60
1906	36 4.5	121 48.6	156.2	18.31	2.24	8.4			0.42	9.58
			156.6	18.37	2.26	8.1			0.38	9.56
			157.0	18.37	2.27	8.1	285.0	0.19	0.47	9.54
			157.4	18.67	2.27	8.2			0.33	9.53
			157.8	18.82	2.28	8.3			0.30	9.49
			158.2	15.57	2.09	7.4			0.26	9.80
			158.6	14.10	2.03	6.9			0.33	10.04
			158.9	13.69			351.0	0.38	0.28	10.12
			159.3	13.54	1.92	7.1			0.36	10.20
			159.7	13.39	1.92	7.0			0.37	10.26
			160.1	13.03	1.93	6.8			0.38	10.31
			160.5	13.15	1.89	7.0			0.34	10.40

R/V ACANIA 10 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	ΔATP / ATP	CHL A MG/M3	TEMP DEG C
1930	36 3.7	121 51.6	160.9	12.42	1.86	6.7	346.0	0.40	0.35	10.43
			161.3						0.33	10.54
			161.7						0.32	10.59
			162.1						0.31	10.50
			162.4						0.29	10.60
			162.8				378.0	0.40	0.26	10.64
			163.2						0.26	10.57
			163.6						0.24	10.50
			164.0						0.21	10.55
			164.4						0.20	10.72
			164.8				320.0	0.40	0.17	10.33
			165.2						0.13	11.00
			165.6						0.09	11.22
			165.9						0.09	11.51
			166.3						0.08	11.66
2000	36 2.3	121 55.0	166.7				139.0	0.29	0.63	11.80
			167.0	6.30	1.52	4.1			0.56	11.90
			167.4	6.06	1.48	4.1			0.56	12.05
			167.7	5.91	1.42	4.2			0.56	12.03
			168.1	5.96	1.41	4.2			0.56	12.10
			168.4	6.01	1.39	4.3	240.0	0.22	0.56	12.11
			168.8	6.16	1.40	4.4			0.56	12.12
			169.1	6.21	1.39	4.5			0.63	12.12
2016	36 1.6	121 56.7	169.4	6.45	1.42	4.5			0.63	12.08
			169.8	6.65	1.42	4.7			0.70	12.07
			170.1	6.75	1.43	4.7	158.0	0.24	0.70	12.03
			170.4	6.75	1.42	4.8			0.70	12.00
			170.7	6.90	1.43	4.8			0.70	11.97
			171.0	7.15	1.44	5.0			0.70	11.90
			171.3	7.44	1.48	5.0			0.70	11.80
2030	36 2.8	121 56.6	171.6	7.79	1.49	5.2	352.0		0.70	11.70
			172.0	8.34	1.51	5.5			0.70	11.63
			172.4	9.03	1.56	5.8			0.70	11.43
			172.8	9.13	1.57	5.8			0.71	11.40
			173.1	9.18	1.58	5.8			0.71	11.35
			173.5	9.67	1.61	6.0	135.0	0.32	0.71	11.25
			173.9	10.52	1.68	6.3			0.71	11.10
			174.3	10.66	1.68	6.3			0.78	11.00
			174.7	10.71	1.68	6.4			0.78	10.99
			175.0	10.76	1.66	6.5			0.78	10.93
			175.4	10.76	1.69	6.4	103.0	0.31	0.99	10.97
			175.8	10.27	1.63	6.3			1.07	11.12
			176.2	10.17	1.64	6.2			1.14	11.13
			176.5	10.22	1.66	6.2			1.07	11.19
			176.9	10.52	1.65	6.4			1.07	11.14
2100	36 5.8	121 55.8	177.3	10.66	1.67	6.4	279.0	0.23	1.07	11.03
			177.7	10.76	1.67	6.4			1.00	11.02
			178.1	10.76	1.67	6.4			1.00	11.05
			178.5	10.86	1.66	6.5			1.00	11.04
			178.9	10.86	1.69	6.4			1.00	10.99

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	ΔATP / ATP	CHL A MG/M3	TEMP DEG C
			179.4	11.11	1.69	6.6	157.0	0.30	1.00	10.95
			179.3	11.41	1.72	6.6			1.00	11.05
			180.2	11.71	1.74	6.7			0.93	11.00
			180.6	12.10	1.78	6.8			0.86	10.93
			181.0	12.35	1.80	6.9			0.93	10.80
2120	36 7.9	121 55.4	181.3	12.50	1.84	6.8	124.0	0.34	0.93	10.70
			181.5	12.65	1.82	7.0			0.93	10.66
			181.8	12.75	1.82	7.0			0.93	10.64
			182.0	12.50	1.78	7.0			0.94	10.64
			182.3	12.05	1.78	6.8			1.15	10.74
2130	36 7.8	121 56.2	182.7	12.35	1.82	6.8	246.0	0.38	1.01	10.85
			183.0	12.30	1.78	6.9			1.01	10.90
			183.4	12.25	1.81	6.8			1.01	10.94
			183.8	12.10	1.78	6.8			1.01	10.97
			184.1	11.95	1.78	6.7			1.01	11.02
			184.5	11.80	1.78	6.6	200.0	0.35	1.01	11.09
			184.9	11.75	1.75	6.7			0.94	11.16
			185.2	11.26	1.74	6.5			1.01	11.13
			185.6	10.81	1.72	6.3			1.02	11.24
			186.0	10.66	1.71	6.2			1.02	11.32
			186.3	10.52	1.71	6.2	223.0	0.27	1.09	11.37
			186.7	10.32	1.69	6.1			1.09	11.36
			187.0	10.37	1.66	6.2			1.09	11.34
			187.4	10.52	1.67	6.3			1.24	11.23
2158	36 6.7	121 59.3	187.8	10.52	1.68	6.3			1.46	11.17
			188.2	10.02	1.65	6.1	295.0	0.36	2.19	[illegible]
			188.6	8.93	1.60	5.6			2.56	10.90
			189.0	8.68	1.61	5.4			2.78	10.94
			189.4	8.19	1.55	5.3			2.93	10.73
			189.9	7.99	1.54	5.2			2.93	11.00
			190.3	7.79	1.50	5.2	786.0	0.33	2.93	11.03
			190.7	7.79	1.52	5.1			2.79	11.05
			191.1	7.89	1.52	5.2			2.72	11.06
			191.5	6.19					2.57	11.05
			191.9	8.29	1.59	5.2			2.43	11.10
			192.3	8.93	1.59	5.6	518.0	0.38	1.03	11.40
			192.7	8.93	1.57	5.7			0.95	11.90
			193.1	7.89	1.55	5.1			1.03	12.00
			193.5	7.79	1.52	5.1			0.96	12.02
			193.9	7.84	1.56	5.0			0.96	11.90
2230	36 3.2	121 59.9	194.4	7.59	1.52	5.0			1.03	12.02
			194.8	7.30	1.52	4.8			0.88	12.06
			195.3	7.15	1.50	4.8			0.86	12.01
			195.7	7.15	1.50	4.8			0.88	12.04
			196.2	7.10	1.50	4.7			0.89	12.10
			196.6	7.10	1.48	4.8	296.0	0.30	0.81	12.15
			197.1	7.20	1.47	4.9			0.81	12.18
2244	36 1.5	121 59.9	197.4	7.15	1.50	4.8			0.81	12.20
			197.7	7.05	1.48	4.8			0.81	12.18
			197.9	6.95	1.48	4.7			0.81	12.15

R/V ACANIA 10-11 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	$\frac{\Delta ATP}{ATP}$	CHL A MG/M3	TEMP DEG C
			198.2	6.90	1.47	4.7	152.0	0.26	0.81	12.15
			198.5	6.90	1.48	4.7			0.82	12.12
			198.8	6.65	1.47	4.7			0.82	12.11
			199.1	6.90	1.48	4.7			0.82	12.05
			199.4	6.90	1.49	4.6			0.82	12.17
			199.6	7.00	1.47	4.8	146.0	0.24	0.82	12.10
			199.9	6.26	1.47	4.3			0.82	
			200.2	6.55	1.48	4.4			0.82	
			200.5	6.35	1.44	4.4			0.82	
			200.8	6.26	1.45	4.3			0.82	
2310	36 3.0	122 1.6	201.1	6.21	1.43	4.3	113.0	0.24	0.82	
			201.3	6.11	1.44	4.2			0.82	
			201.6	6.06	1.45	4.2			0.82	
			201.9	6.06	1.45	4.2			0.82	
			202.2	6.06	1.45	4.2			0.82	
			202.4	6.11	1.45	4.2	117.0	0.23	0.82	
			202.7	6.21	1.45	4.3			0.82	
			203.0	6.30	1.45	4.3			0.82	
			203.3	6.35					0.82	
			203.6						0.83	
2330	36 4.3	122 2.5	203.8				182.0	0.16	0.83	
			204.1						0.83	
			204.4						0.83	
			204.7						0.90	
			204.9	7.15	1.55	4.6			0.98	
			205.2	7.44	1.52	4.9	215.0	0.31	0.98	
			205.5	7.54	1.50	5.0			1.06	
			205.8	7.59	1.50	5.1			1.06	12.25
			206.1	7.84	1.51	5.2			1.06	12.22
			206.3	7.94	1.54	5.2			1.06	12.05
			206.6	10.57	1.52	7.0	295.0	0.11	1.06	12.00
			206.9	10.81	1.53	7.1			1.14	11.35
			207.2	9.33	1.56	6.0			1.14	11.63
			207.4	9.53	1.60	6.0			1.14	11.50
			207.7	9.87	1.62	6.1			1.21	11.37
0000	36 6.2	122 3.9	208.1	10.12	1.64	6.2	207.0	0.33	1.26	11.35
			208.4	10.17	1.65	6.2			1.21	11.31
			208.8	10.37	1.69	6.1			1.21	11.29
			209.2	10.52	1.69	6.2			1.21	11.28
			209.5	10.81	1.72	6.3			1.21	11.24
			209.9	11.01			211.0	0.34	1.21	11.20
			210.3	11.01	1.73	6.4			1.20	11.16
			210.6	11.35	1.74	6.5			1.20	11.05
			211.0	11.41	1.73	6.6			1.28	10.93
			211.4	9.67	1.65	5.9			1.35	11.07
			211.7	9.33	1.64	5.7	347.0	0.47	1.42	11.10
			212.1	9.62	1.65	5.8			2.77	11.21
			212.5	9.67	1.65	5.9			2.77	11.22
			212.8	10.02	1.66	6.0			2.54	11.20
			213.2	10.17	1.69	6.0			2.32	11.19

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
0030	36 8.6	122 6.0	213.6	10.52	1.70	6.2	497.0	0.36	2.10	11.17
			213.9	10.57	1.68	6.3			1.86	11.16
			214.3	10.52	1.67	6.3			1.73	11.14
			214.7	10.32	1.68	6.1			1.78	11.12
			215.0	10.07	1.67	6.0			1.93	11.09
			215.4	9.92	1.67	5.9	421.0	0.41	2.07	11.04
			215.8	9.92	1.67	5.9			2.29	11.00
			216.1	9.82	1.65	6.0			2.59	10.95
			216.5	10.37	1.67	6.2			2.66	10.92
			216.9	10.17	1.69	6.0			2.80	10.89
			217.3	10.37	1.69	6.1	528.0	0.36	2.87	10.82
			217.6	10.52	1.71	6.2			2.67	10.75
			218.0	10.57	1.70	6.2			2.87	10.75
			218.4	10.37	1.69	6.2			4.00	10.74
			218.7	10.32	1.69	6.1			2.86	10.73
0100	36 10.9	122 8.4	218.9				560.0	0.37	2.93	10.72
			219.1	10.17	1.67	6.1			2.93	10.73
			219.3	10.27	1.67	6.1			2.99	10.73
			219.4	10.22	1.68	6.1			3.06	10.74
			219.6	10.27	1.69	6.1			2.99	10.72
			219.8	10.62	1.70	6.2	183.0	0.46	3.06	10.50
			220.0	11.26	1.75	6.4			2.63	10.45
			220.1	12.19	1.79	6.8			2.73	10.41
			220.3	12.70	1.82	7.0			2.39	10.29
			220.5	13.74	1.89	7.3			2.17	10.12
			220.6	14.53	1.92	7.6	278.0	0.47	1.95	10.13
			220.8						1.94	10.17
			221.0						1.94	10.27
			221.2	13.54	1.80	7.5			1.94	10.26
			221.3	13.54	1.80	7.5			2.01	10.26
0130	36 11.7	122 9.9	221.5	13.39	1.80	7.4	431.0	0.37	2.01	10.30
			221.6	13.29	1.81	7.3			1.57	10.25
			221.8	13.64	1.83	7.5			1.57	10.23
			222.0	13.39	1.82	7.4			1.57	10.43
			222.1	12.75	1.77	7.2			1.57	10.44
			222.3	12.70	1.78	7.1	297.0	0.37	1.49	10.50
			222.4	12.20	1.74	7.0			1.56	10.65
			222.6	11.85	1.72	6.9			1.70	10.60
			222.7	12.05	1.73	7.0			1.64	10.49
			222.9	12.40	1.74	7.1			1.70	10.55
			223.0	12.00	1.73	6.9	267.0	0.39	1.55	10.80
			223.2	11.36	1.70	6.7			1.62	10.83
			223.3	11.06	1.69	6.5			1.48	10.98
			223.5	10.91	1.68	6.5			1.20	11.00
			223.6	11.01	1.68	6.6			1.18	11.02
0200	36 12.3	122 11.3	223.9				152.0	0.22	1.12	10.93
			224.1						1.12	10.99
			224.3						1.11	10.97
			224.5						1.11	10.83
			224.7						1.17	10.84

R/V ACANIA 11 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			224.9				57.0	0.01	1.21	10.97
			225.1	11.36	1.80	6.3			1.23	10.79
			225.3	9.43	1.59	6.0			1.16	11.04
			225.5	10.71	1.73	6.2			1.16	11.00
			225.7	8.93	1.62	5.5			1.15	10.67
			226.0	11.06	1.70	6.5	327.0	0.36	1.21	10.30
			226.2	11.80	1.75	6.7			1.48	10.33
			226.4	13.07	1.84	7.1			1.47	10.10
			226.6	13.59	1.86	7.4			1.47	10.03
			226.8	14.43	1.95	7.4			1.40	10.04
0230	36 12.2	122 9.2	227.1	14.03	1.93	7.3	332.0	0.42	1.46	10.15
			227.5	14.38	1.94	7.4			1.58	10.10
			227.8	13.04	1.84	7.1			1.64	10.13
			228.2	14.78	1.95	7.6			1.64	9.95
			228.5	14.63	1.96	7.5			1.70	10.06
			228.9	14.18	1.99	7.1	455.0	0.41	1.75	10.10
			229.2	14.03	1.91	7.3			1.75	10.31
			229.6	13.79	1.93	7.1			1.80	10.52
			229.9	11.90	1.79	6.6			2.28	10.58
			230.3	11.16	1.73	6.5			2.56	10.70
			230.6	10.66	1.72	6.2	675.0	0.33	2.42	10.71
			230.9						2.35	10.72
			231.3	11.66	1.74	6.7			2.21	10.74
			231.6						2.14	10.79
			232.0						1.88	10.81
0300	36 11.9	122 5.7	232.3	11.66	1.75	6.7	360.0	0.41	2.06	10.82
			232.7	11.71	1.76	6.7			2.05	10.77
			233.1	10.71	1.77	6.1			1.98	10.73
			233.4	11.80	1.77	6.7			2.03	10.74
			233.8	11.56	1.77	6.5			2.03	10.76
			234.1	12.80			654.0	0.28	2.08	10.75
			234.5	14.93	1.77	8.4			2.01	10.73
			234.8	13.89	1.76	7.9			1.54	10.69
			235.2	13.49	1.76	7.7			1.81	10.55
			235.6	15.42	1.78	8.7			1.80	10.63
			235.9	17.60	1.79	9.8	584.0	0.25	1.73	10.57
			236.3	18.20	1.79	10.2			1.67	10.55
			236.6		1.80				1.60	10.53
			237.0						1.53	10.50
			237.4						1.53	10.47
0330	36 11.9	122 2.1	237.6				261.0	0.28	1.53	10.47
			237.9		1.86				1.52	10.42
			238.1		1.86				1.51	10.44
			238.4		1.86				1.56	10.44
			238.7		1.88				1.62	10.44
			238.9				434.0	0.29	1.61	10.36
			239.2						1.54	10.24
			239.5						1.14	9.34
			239.7						0.90	9.66
			240.0						0.90	9.64

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP / ATP	CHL A MG/M3	TEMP DEG C
			240.3				183.0	0.23	1.07	9.73
			240.5						1.06	9.70
			240.8						0.94	9.67
			241.1						0.88	9.40
			241.3						0.86	9.33
0400	36 11.7	121 59.5	241.5				146.0	0.28	0.82	9.30
			241.7						0.82	9.23
			241.9	18.59	2.29	8.1			0.81	9.23
			242.0	18.79	2.23	8.4			0.86	9.20
			242.2	19.04	2.27	8.4			0.86	9.13
			242.4	18.94	2.28	8.3	231.0	0.18	0.85	9.16
			242.5	19.29	2.28	8.5			0.85	9.09
			242.7	19.48	2.28	8.5			0.85	9.06
			242.9	19.68	2.31	8.5			0.84	9.04
			243.1	19.88	2.30	8.6			0.84	9.13
			243.2	19.98	2.30	8.7	174.0	0.27	0.83	9.15
			243.4	19.68	2.30	8.6			0.83	9.20
			243.6	19.48	2.29	8.5			0.83	9.23
			243.8	19.29	2.26	8.5			0.77	9.25
			243.9	19.19	2.27	8.5			0.82	9.27
0430	36 10.8	121 58.1	244.1	19.24	2.27	8.5	234.0	0.25	0.81	9.31
			244.2	18.94	2.24	8.5			0.86	9.35
			244.4	18.64	2.25	8.3			0.91	9.3[illegible]
			244.5	18.44	2.22	8.3			1.05	9.45
			244.7	18.25	2.21	8.3			1.24	9.70
			244.9	17.95	2.19	8.2	150.0	0.13	1.26	9.83
			245.0	16.41	2.09	7.9			1.23	10.25
			245.2	15.37	2.02	7.6			1.02	10.17
			245.3	13.59	1.91	7.1			1.12	10.20
			245.5	14.08	1.93	7.3			1.16	10.30
			245.6	14.28	1.93	7.4	223.0	0.29	1.25	10.55
			245.8	13.74	1.90	7.2			1.24	10.63
			245.9	12.94	1.85	7.0			1.33	10.55
			246.1	12.55	1.82	6.9			1.32	10.80
			246.2	12.25	1.80	6.8			1.36	10.90
0500	36 8.8	121 59.4	246.5	12.00	1.78	6.7	334.0	0.33	1.35	11.00
			246.7	11.66	1.73	6.7			1.34	11.05
			247.0	11.31	1.72	6.6			1.33	11.07
			247.3	11.16	1.69	6.6			1.32	11.09
			247.5	11.16	1.71	6.5			1.40	11.13
			247.8	11.06	1.70	6.5	404.0	0.26	1.44	11.11
			248.0	11.01	1.72	6.4			1.61	11.12
			248.3	10.81	1.68	6.4			1.73	11.13
			248.5	10.52	1.65	6.4			1.81	11.15
			248.8	10.27	1.65	6.2			1.94	11.14
			249.0	9.87	1.67	5.9	568.0	0.32	2.01	11.14
			249.3	9.57	1.61	5.9			1.96	11.17
			249.5	9.33	1.59	5.9			1.94	11.15
			249.8	9.23	1.58	5.8			1.85	11.13
			250.0	9.03	1.56	5.8			1.84	11.17

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
0530	36 7.1	122 0.9	250.3	9.03	1.56	5.8	408.0	0.35	1.52	11.16
			250.5	9.08	1.54	5.9			1.81	11.17
			250.8	9.08	1.55	5.9			1.59	11.19
			251.0	9.08	1.60	5.7			0.83	11.20
			251.2	9.03	1.57	5.8			0.74	11.19
			251.5	8.98	1.56	5.8	537.0	0.22	0.74	11.11
			251.7	8.93	1.60	5.6			0.73	11.05
			252.0	9.72	1.65	5.9			0.73	11.05
			252.2	10.52	1.71	6.2			0.76	11.10
			252.4	11.11	1.72	6.5			0.72	11.31
			252.7	10.85	1.71	6.4	212.0	0.26	0.67	11.43
			252.9	10.70	1.65	6.5			0.67	11.51
			253.2	9.72	1.64	5.9			0.67	11.64
			253.4	9.03	1.59	5.7			0.67	11.60
			253.6						0.67	11.66
0600	36 5.6	122 2.4	253.9	8.68	1.56	5.6	217.0	0.23	0.66	11.67
			254.2	8.44	1.57	5.4			0.66	11.49
			254.5	8.09	1.53	5.3			0.58	11.71
			254.8	8.14	1.56	5.2			0.58	11.85
			255.1	7.89	1.53	5.2			0.65	11.75
			255.4	7.49	1.51	5.0			0.65	11.76
			255.7	7.79	1.52	5.1			0.61	12.12
			256.0	7.74	1.51	5.1			0.61	12.25
			256.3	7.00	1.43	4.9			0.57	12.30
			256.6	6.40	1.41	4.5			0.53	12.37
			256.8	6.01	1.41	4.3			0.52	12.40
			257.1	5.56	1.36	4.1			0.52	12.41
			257.4	5.51					0.52	12.38
			257.7	5.46	1.35	4.0			0.52	12.42
			258.0	5.36	1.34	4.0			0.52	12.45
0630	36 3.7	122 4.2	258.2	4.97	1.33	3.7			0.48	12.48
			258.3	4.52	1.29	3.5			0.44	12.57
			258.5	3.83	1.25	3.1			0.47	12.65
			258.6	3.88	1.28	3.0			0.47	12.75
			258.8	3.56	1.23	2.9			0.43	12.83
			259.0	3.03	1.19	2.6	160.0	0.11	0.39	12.94
			259.1	2.69	1.19	2.3			0.39	12.96
			259.3	2.54	1.17	2.2			0.39	12.98
			259.4	2.49	1.16	2.1			0.39	13.06
			259.6	2.44	1.16	2.1			0.39	13.19
			259.8	2.29	1.16	2.0	134.0	0.16	0.39	13.23
			259.9	2.04	1.13	1.8			0.38	13.25
			260.1	1.85	1.14	1.6			0.42	13.28
			260.2	1.75	1.11	1.6			0.42	13.30
			260.4	1.65					0.42	13.32
0700	36 2.6	122 5.1	260.5	1.70	1.12	1.5	87.0	0.09	0.41	13.32
			260.7	1.70	1.10	1.5			0.41	13.35
			260.8	1.65	1.10	1.5			0.41	13.33
			260.9	1.55	1.09	1.4			0.41	13.42
			261.1	1.40	1.09	1.3			0.41	13.44

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			261.2	1.25	1.08	1.2	76.0	0.01	0.41	13.47
			261.3	1.15	1.08	1.1			0.41	13.54
			261.4	0.95	1.07	0.9			0.27	13.57
			261.6	0.90	1.05	0.9			0.40	13.53
			261.7	0.90	1.04	0.9			0.40	13.54
			261.8	0.90	1.04	0.9	115.0	0.01	0.40	13.56
			262.0	0.90	1.04	0.9			0.40	13.58
			262.1	0.90	1.03	0.9			0.43	13.56
			262.2	0.90	1.02	0.9			0.40	13.54
			262.4	0.90	1.00	0.9			0.43	13.53
0730	36 1.8	122 5.8	262.5	0.85	0.99	0.9	147.0	0.21	0.43	13.52
			262.6	0.85	0.99	0.9			0.42	13.51
			262.7	0.85	0.99	0.9			0.42	13.50
			262.8						0.42	13.50
			262.9						0.42	13.50
			263.1						0.42	13.48
			263.2						0.39	13.47
			263.3						0.38	13.45
			263.4						0.38	13.44
			263.5						0.36	13.43
			263.6				146.0	0.22	0.38	13.42
			263.8						0.38	13.44
			263.9						0.38	13.43
			264.0						0.38	13.42
			264.1						0.38	13.41
0800	36 2.5	122 5.0	264.2				128.0	0.09	0.39	13.41
			264.4	0.52	1.02	0.5			0.38	13.41
			264.5	0.57	1.01	0.6			0.38	13.40
			264.6	0.67	1.01	0.7			0.38	13.37
			264.8	0.77	1.01	0.8			0.34	13.37
			264.9	0.87	0.98	0.9			0.34	13.37
			265.0	0.92	0.98	0.9			0.34	13.37
			265.1	1.02	0.99	1.0			0.38	13.35
			265.3	1.07	0.99	1.1			0.34	13.32
			265.4	1.17	0.98	1.2			0.38	13.30
			265.5	1.22	1.05	1.2			0.38	13.27
			265.7	1.31	1.03	1.3			0.36	13.27
			265.8	1.76	1.02	1.7			0.38	13.26
			265.9	1.41	1.02	1.4			0.38	13.25
			266.1	1.46	1.01	1.4			0.34	13.23
0830	36 3.3	122 4.2	266.2	1.45	1.01	1.4			0.34	13.17
			266.3	1.61	1.02	1.6			0.34	13.17
			266.4	1.55	1.01	1.5			0.34	13.14
			266.6	1.66	1.00	1.7			0.34	13.15
			266.7	1.66	1.00	1.7			0.34	13.06
			266.8	1.61	1.01	1.6	122.0	0.11	0.34	13.04
			267.0	1.71	1.03	1.7			0.34	13.00
			267.1	1.86	1.04	1.8			0.34	12.97
			267.2	1.86	1.04	1.8			0.34	12.85
			267.4	1.86	1.06	1.8			0.34	12.80

R/V ACANIA 11 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH		LONGITUDE WEST		DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP / ATP	CHL A MG/M3	TEMP DEG C
					267.5	2.25	1.09	2.1	113.0	0.04	0.34	12.72
					267.6	2.35	1.09	2.2			0.34	12.65
					267.7	2.45	1.10	2.2			0.34	12.63
					267.9	2.65	1.12	2.4			0.34	12.60
					268.0	2.79	1.12	2.5			0.34	12.60
0900	36	4.2	122	3.6	268.1	2.34	1.12	2.5	130.0	0.05	0.38	12.59
					268.2	2.84	1.13	2.5			0.38	12.59
					268.3	2.79	1.13	2.5			0.38	12.57
					268.4	2.79	1.11	2.5			0.39	12.57
					268.6	2.79	1.12	2.5			0.39	12.57
					268.7	2.79	1.12	2.5	131.0	0.11	0.40	12.58
					268.8	2.79	1.12	2.5			0.40	12.55
					268.9	2.79	1.11	2.5			0.40	12.53
					269.0	2.79	1.12	2.5			0.41	12.53
					269.1	2.94	1.11	2.6			0.41	12.50
					269.2	2.99	1.14	2.6	176.0	0.13	0.42	12.47
					269.3	2.94	1.14	2.6			0.42	12.44
					269.4	2.99	1.13	2.6			0.42	12.40
					269.6	3.29	1.13	2.9			0.43	12.38
					269.7	3.53	1.17	3.0			0.43	12.36
0930	36	5.0	122	3.1	269.8	3.53	1.16	3.0	104.0	0.14	0.44	12.34
					269.9	3.58	1.13	3.0			0.44	12.32
					270.0	3.68					0.44	12.27
					270.1	3.73	1.17	3.2			0.45	12.25
					270.2	3.78	1.18	3.2			0.45	12.20
					270.3	3.88	1.20	3.2	138.0	0.22	0.45	12.16
					270.4	4.17	1.20	3.5			0.46	12.14
					270.5	4.17	1.22	3.4			0.46	12.11
					270.6	4.47	1.22	3.7			0.47	12.10
					270.7	4.52	1.22	3.7			0.47	12.07
					270.8	4.67	1.24	3.8	122.0	0.06	0.47	12.05
					270.9	4.82	1.25	3.9			0.48	12.02
					271.0	5.06	1.25	4.0			0.49	12.00
					271.1	5.16	1.26	4.1			0.49	12.00
					271.2	5.36	1.28	4.2			0.53	11.96
1000	36	5.8	122	2.7	271.3	5.36	1.29	4.2	153.0	0.13	0.53	11.95
					271.4	5.46	1.29	4.2			0.53	11.94
					271.6	5.60	1.30	4.3			0.52	11.92
					271.7	5.70	1.28	4.5			0.52	11.89
					271.8	5.75	1.31	4.4			0.51	11.88
					271.9	5.90	1.31	4.5	170.0	0.18	0.51	11.87
					272.0	5.95	1.31	4.5			0.50	11.87
					272.1	6.10	1.33	4.6			0.50	11.86
					272.2	6.15	1.31	4.7			0.49	11.81
					272.3						0.49	11.80
					272.4				159.0	0.13	0.49	11.80
					272.5	6.25	1.32	4.7			0.48	11.80
					272.6	6.39	1.34	4.8			0.47	11.80
					272.7	6.49	1.33	4.9			0.47	11.77
					272.8	6.69	1.36	4.9			0.46	11.75

R/V ACANIA 11 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A UG/M3	TEMP DEG C
1030	36 6.8	122 2.4	272.9	6.84	1.36	5.0	189.0	0.33	0.46	11.59
			273.0	7.03	1.36	5.2			0.45	11.65
			273.1	7.33	1.40	5.2			0.45	11.55
			273.3	7.53	1.39	5.4			0.47	11.53
			273.4	7.58	1.40	5.4			0.47	11.41
			273.5	7.97	1.42	5.6			0.46	11.35
			273.6	8.66	1.45	6.0			0.46	11.32
			273.7	8.76	1.46	6.0			0.45	11.37
			273.8	8.95	1.47	6.1			0.48	11.39
			273.9	8.81	1.46	6.0			0.50	11.35
			274.0	8.86	1.46	6.1	118.0	0.30	0.47	11.34
			274.1	8.96	1.47	6.1			0.49	11.30
			274.3	9.06	1.47	6.2			0.52	11.28
			274.4	9.15	1.48	6.2			0.51	11.25
			274.5	9.35	1.48	6.3			0.50	11.23
			274.6	9.40	1.49	6.3			0.50	11.15
1102	36 7.7	122 1.9	274.8						0.59	11.13
			275.1	9.75	1.53	6.4			0.71	11.07
			275.4	9.80	1.52	6.4			0.81	11.00
			275.6	9.99	1.54	6.5			0.95	10.84
			275.9	10.34	1.55	6.7	164.0	0.25	1.05	10.78
			276.2	10.73	1.57	6.8			1.09	10.62
			276.4	11.13	1.59	7.0			1.19	10.73
			276.7	11.67	1.64	7.1			1.25	10.77
			277.0	11.22	1.60	7.0			1.53	10.92
			277.2	10.64	1.56	6.8			2.18	10.93
			277.5	9.99	1.52	6.6			2.68	10.99
			277.8	9.75	1.50	6.5			2.83	11.02
			278.0	9.65	1.50	6.4			3.19	11.03
			278.3	9.55	1.50	6.4			3.30	11.05
1130	36 8.8	122 1.9	278.5	9.55	1.49	6.4	331.0	0.37	3.63	11.06
			278.6	9.50	1.49	6.4			3.80	11.07
			278.8	9.55	1.49	6.4			4.01	11.05
			278.9	9.55	1.51	6.3			4.04	11.06
			279.1	9.55	1.52	6.3			4.20	11.06
			279.3	9.60	1.49	6.4			4.35	11.05
			279.4	9.65	1.49	6.5			4.51	11.04
			279.6	9.60	1.48	6.5			4.67	11.02
			279.7	9.30	1.50	6.5			4.83	11.00
			279.9	9.94	1.48	6.7			4.99	11.00
			280.1	10.04	1.50	6.7	277.0	0.34	5.14	11.00
			280.2	10.04	1.49	6.7			5.48	10.97
			280.4	10.04	1.50	6.7			5.64	10.77
			280.5	9.99	1.49	6.7			5.80	10.96
			280.7	9.94	1.52	6.5			5.32	10.94
1200	36 10.1	122 2.1	280.9	10.29	1.53	6.7			5.32	10.83
			281.1						5.39	10.82
			281.2						5.45	10.83
			281.4	10.34					5.33	10.86
			281.6	10.34	1.52	6.8			5.21	10.78

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR. RATIO NO3/PO4	ATP NG/L	$\frac{\Delta ATP}{ATP}$	CHL A MG/M3	TEMP DEG C
			281.8	10.44	1.54	6.8	236.0	0.36	5.59	10.48
			282.0	10.14	1.53	6.6			4.82	10.50
			282.1	10.39	1.53	6.8			4.08	10.23
			282.3	11.37	1.62	7.0			3.93	10.13
			282.5	11.77	1.64	7.2			3.13	10.05
			282.7	12.41	1.67	7.4			2.61	10.00
			282.9	13.25	1.74	7.6			2.40	9.94
			283.0	13.64	1.76	7.8			2.34	9.94
			283.2	13.64	1.80	7.7			2.14	9.85
1228	36 11.4	122 2.4	283.4	14.13	1.80	7.9			2.09	9.84
			283.6	14.14	1.79	7.9	123.0	0.38	1.97	9.80
			283.7	14.38	1.82	7.9			1.83	9.77
			283.9	14.73	1.81	8.1			1.78	9.76
			284.1	14.73	1.82	8.1			1.72	9.76
			284.3	14.88	1.84	8.1			1.55	9.63
			284.5	15.02	1.85	8.1			1.39	9.62
			284.6	15.02	1.85	8.1			1.34	9.55
			284.8	15.37	1.89	8.1			1.29	9.53
			285.0	15.36	1.90	8.3			1.24	9.50
			285.2	16.06	1.93	8.3			1.19	9.49
			285.4	16.21	1.94	8.4	130.0	0.17	1.14	9.47
			285.5	16.41	1.94	8.5			1.05	9.44
			285.7	16.50	1.97	8.4			1.04	9.43
			285.9	16.55	1.94	8.5			0.99	9.40
			286.1	16.70	1.96	8.5			0.95	9.28
1300	36 12.9	122 2.6	286.3	16.45	1.97	8.4			0.95	9.23
			286.5						0.95	9.20
			286.7						1.03	9.20
			286.9						1.04	9.20
			287.1						1.04	9.20
			287.3				193.0	0.32	1.05	9.20
			287.5	18.03	2.09	8.6			1.13	9.21
			287.7	17.98	2.08	8.6			1.14	9.22
			287.9	17.98	2.07	8.7			1.14	9.21
			288.1	17.98	2.07	8.7			1.15	9.21
			288.3	17.84	2.07	8.6			1.23	9.20
			288.5	17.89	2.07	8.6			1.16	9.20
			288.7	17.84	2.07	8.6			1.24	9.18
			288.9	17.79	2.06	8.6			1.25	9.18
			289.1	17.93	2.07	8.7			1.25	9.31
1330	36 14.5	122 2.6	289.3	17.93	2.06	8.7	145.0	0.15	1.26	9.25
			289.5	17.93	2.06	8.7			1.27	9.24
			289.7	17.93	2.07	8.7			1.27	9.23
			289.9	17.49	2.06	8.5			1.28	9.22
			290.1	17.34	2.04	8.5			1.36	9.20
			290.3	17.49	2.04	8.6			1.37	9.20
			290.5	17.49	2.08	8.4			1.35	9.23
			290.7	17.59	2.04	8.6			1.36	9.24
			290.9	17.79	2.07	8.6			1.31	9.31
			291.1	17.69	2.07	8.5			1.31	9.35

R/V ACANIA   11 JUNE 1980   CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			291.3	17.54	2.07	8.5	76.0	0.29	1.40	9.33
			291.5	17.00	2.00	8.5			1.49	9.37
			291.7	16.65	1.99	8.4			1.50	9.33
			291.9	16.50	2.00	8.3			1.59	9.44
			292.1	16.50	2.00	8.3			1.51	9.50
1400	36 16.1	122 2.6	292.3	16.40	1.98	8.3			1.59	9.52
			292.5	15.62	1.95	8.0			1.58	9.73
			292.7	14.93	1.89	7.9			1.57	9.82
			292.9	14.83	1.88	7.9			1.65	9.96
			293.0	13.94	1.83	7.6			1.74	10.04
			293.2	13.40	1.79	7.5	190.0	0.25	1.71	10.12
			293.4	12.95	1.72	7.5			1.72	10.25
			293.6	12.16	1.69	7.2			1.61	10.26
			293.8	11.57	1.66	7.0			1.69	10.30
			294.0	11.18	1.63	6.9			1.76	10.39
			294.2	10.93	1.59	6.9			1.91	10.47
			294.4	10.73	1.59	6.7			1.90	10.52
			294.6	10.49	1.57	6.7			2.05	10.47
			294.8	10.34	1.55	6.7			2.19	10.53
			295.0	10.19	1.54	6.6			2.24	10.51
1430	36 17.7	122 2.6	295.1	10.14	1.52	6.7	448.0	0.35	2.25	10.50
			295.3	10.14	1.52	6.7			2.24	11.00
			295.5	10.29	1.53	6.7			2.30	11.19
			295.7	9.90	1.49	6.6			2.52	11.24
			295.9	7.48	1.36	5.5			2.66	11.14
			296.1	6.99	1.33	5.3			2.34	11.15
			296.3	6.79	1.31	5.2			2.04	11.14
			296.5	7.03					1.79	11.16
			296.7						1.73	11.23
			296.9						1.55	11.22
			297.1				263.0	0.35	1.62	11.22
			297.3						1.97	11.27
			297.4						1.59	11.25
			297.6						2.01	11.29
			297.8	7.08	1.40	5.1			2.04	11.30
1500	36 19.2	122 2.7	298.3	7.18	1.36	5.3			2.03	11.24
			298.7	7.33	1.36	5.4			2.01	11.26
			299.1	7.03	1.33	5.3			1.93	11.27
			299.6	7.13	1.32	5.4			1.92	11.35
			300.0	7.08	1.34	5.3			1.94	11.33
			300.4	7.13	1.33	5.4	215.0	0.39	1.90	11.35
			300.9	6.89	1.34	5.1			1.89	11.42
			301.3	6.64	1.31	5.1			1.88	11.47
			301.7	6.64	1.34	5.0			1.93	11.46
			302.1	6.59	1.31	5.0			1.99	11.52
			302.6	6.29	1.28	4.9	468.0	0.39	1.84	11.55
			303.0	5.90	1.26	4.7			1.83	11.52
			303.4	5.75	1.26	4.6			1.69	11.50
			303.9	5.41	1.24	4.4			1.74	11.61
			304.3	5.26	1.21	4.3			2.00	11.66

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
1530	36 22.7	122 4.5	304.8	5.06	1.19	4.3	449.0	0.33	2.06	11.70
			305.4	4.86	1.54	3.2			2.04	11.71
			305.9	4.47	1.13	4.0			2.49	11.73
			306.4	3.83	1.09	3.5			2.47	11.75
			306.9	3.73	1.08	3.5			2.39	11.73
			307.5	3.53	1.03	3.3	482.0	0.47	2.51	11.80
			308.0	3.24	1.07	3.0			2.62	11.59
			308.5	3.19	1.07	3.0			2.60	11.62
			309.0	3.09					2.71	11.60
			309.6	4.42	1.13	3.9			2.76	11.57
			310.1	5.65	1.23	4.6	332.0	0.37	2.68	11.60
			310.6	6.25	1.29	4.8			2.60	11.59
			311.1	6.49	1.33	4.9			1.35	11.57
			311.7	6.59	1.33	5.0			1.10	11.40
			312.2	6.74	1.33	5.1			0.91	11.42
1600	36 26.8	122 4.4	312.7	6.64	1.33	5.0	180.0	0.28	0.90	11.43
			313.1	6.49	1.33	4.9			0.78	11.53
			313.6	6.74	1.33	5.1			0.78	11.57
			314.1	6.59	1.32	5.0			0.78	11.69
			314.6	6.54	1.32	5.0			0.84	11.71
			315.0	6.25	1.32	4.7	227.0	0.32	0.84	11.75
			315.5	6.00	1.27	4.7			0.85	11.80
			316.0	5.90	1.30	4.5			0.85	11.80
			316.5	5.95	1.29	4.6			0.91	11.75
			316.9	5.95	1.28	4.6			0.91	11.60
			317.4	5.90	1.29	4.6	135.0	0.48	0.91	11.60
			317.9	5.95	1.29	4.6			0.85	11.57
			318.4	6.29	1.31	4.8			0.87	11.52
			318.8	6.49	1.40	4.6			0.80	11.50
			319.3	6.59	1.30	5.1			0.74	11.43
1630	36 30.7	122 4.8	319.8	6.74	1.33	5.1	82.0	0.29	0.74	11.40
			320.3	6.94	1.37	5.1			0.74	11.43
			320.7	7.03	1.36	5.2			0.74	11.57
			321.2	7.23	1.38	5.2			0.74	11.70
			321.7	6.74	1.32	5.1			0.74	11.63
			322.2	6.69	1.32	5.1	177.0	0.38	0.75	11.63
			322.6	5.95	1.27	4.7			0.75	11.62
			323.1	5.80	1.26	4.6			0.75	11.55
			323.6	6.00	1.27	4.7			0.75	11.65
			324.1	5.90	1.23	4.6			0.81	11.64
			324.5	6.05	1.31	4.6	435.0	0.32	1.07	11.63
			325.0	5.60	1.26	4.4			1.32	11.65
			325.5	5.11	1.21	4.2			1.33	11.50
			326.0	4.03					1.33	11.35
			326.4	4.57					1.27	11.37
1700	36 34.5	122 5.4	326.9	5.41	1.27	4.3	555.0	0.46	1.46	11.29
			327.4	5.80	1.27	4.6			1.59	11.33
			327.9	6.44					1.72	11.32
			328.3	6.00	1.31	4.6			2.11	11.79
			328.8		1.32				1.92	11.85

R/V ACANIA 11 JUNE 1980 CHEMICAL MESOSCALE (CRUISE XII)

TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DISTANCE KM	NO3 UM	PO4 UM	NUTR.RATIO NO3/PO4	ATP NG/L	ΔATP/ATP	CHL A MG/M3	TEMP DEG C
			329.3		1.33		231.0	0.46	1.67	11.36
			329.8		1.23				1.48	11.77
			330.2	3.58					1.68	11.57
			330.7						1.62	12.00
			331.2		1.11				1.49	12.00
			331.7	4.12			509.0	0.43	1.49	12.00
			332.1	4.27					1.72	12.07
			332.6	4.42					1.76	12.13
			333.1						1.79	12.20
			333.6	4.86					1.70	12.15
1730	36 37.8	122 0.9	334.2	2.39			582.0	0.50	1.77	12.28
			334.8		1.02				1.84	12.12
			335.4	2.00	1.02	2.0			1.81	12.20
			336.0		0.99				1.85	12.25
			336.6						1.72	12.35
			337.2				573.0	0.55	1.65	12.45
			337.8						1.52	12.50
			338.4						1.19	12.55
			339.0						1.26	12.65
			339.6						1.47	12.60
			340.2				718.0	0.38	1.40	12.30
			340.8						1.40	12.70
			341.4						1.47	12.60
			342.0						1.54	12.50
			342.6						1.54	12.70
1800	36 38.4	121 55.4	342.6				640.0	0.56	1.55	12.90

APPENDIX B

Listing of Nansen Cast Data: Station, Time, Latitude Longitude, Depth, Salinity, Temperature, Density, Nitrate, ATP

R/V ACANIA 29-30 NOVEMBER 1979 CHEMICAL MESOSCALE (CRUISE X)

STATION #	TIME GMT	LATITUDE NORTH	LONGITUDE WEST	DEPTH M	SALINITY PPT	TEMPERATURE DEG C	DENSITY SIGMA T	NO3 UM	ATP NG/L
1	2002	36 15.8	122 4.8	2.5	33.423	14.30	26.47	1.44	79.0
				25.0	33.423	12.31	26.35	9.80	41.0
				50.0	32.388	10.20	25.49	18.21	
				100.0	33.746	9.43	26.54	21.54	
				200.0	34.034	8.14	26.78	27.03	
				300.0	34.091	7.73	26.84	30.06	
				400.0	34.158	7.46	26.90	32.05	
2	2134	36 11.4	121 59.7	2.5	33.470	14.80	26.54	0.76	57.0
				25.0	33.470	13.17	26.43	7.14	156.0
				50.0	33.478	10.99	26.35	14.88	
				100.0	33.731	9.80	26.53	20.25	
				175.0	33.987	8.28	26.74	25.19	
				292.0	34.097	7.51	26.85	30.81	
				395.0	34.164	7.00	26.92	33.33	
3	2241	36 12.1	122 3.0	2.5	33.483	13.00	26.43	6.61	112.0
				25.0	33.483	12.69	26.41	8.14	165.0
				50.0	33.483	10.85	26.35	15.24	
				100.0	33.827	9.34	26.60	21.86	
				180.0	34.009	8.30	26.76	25.87	
				280.0	34.021	7.47	26.79	25.79	
				360.0	34.111	7.12	26.88	32.65	
4	2343	36 12.0	122 8.0	2.5	33.489	13.65	26.47	3.44	65.0
				25.0	33.489	12.73	25.42	8.34	86.0
				50.0	33.523	11.99	26.41	11.79	31.0
				100.0	33.614	9.62	26.44	19.77	
				200.0	33.969	7.26	26.76	24.91	
				300.0	34.076	6.86	26.86	30.60	
				400.0	34.272	6.54	27.03	34.78	
5	0044	36 16.2	122 9.9	2.5	33.547	12.90	26.48	5.33	99.0
				25.0	33.547	12.58	26.46	8.02	162.0
				50.0	33.587	10.64	26.42	16.21	14.0
				100.0	33.751	9.28	26.54	21.37	
				180.0	34.007	8.37	26.76	26.04	
				295.0	34.121	7.28	26.88	30.58	
				400.0	34.227	6.81	26.96	34.76	
6	0136	36 19.1	122 12.9	2.5	33.425	13.20	26.40	3.68	157.0
				25.0	33.425	13.22	26.40	5.68	25.0
				50.0	33.552	12.21	26.45	11.25	98.0
				100.0	33.676	9.74	26.48	20.04	
				172.0	34.202	7.85	26.92	28.47	
				296.0	34.050	7.42	26.82	33.33	
				400.0	34.296	6.93	27.03	35.85	
7	0300	36 22.0	122 3.8	2.5	33.509	12.70	26.44	7.05	85.0
				25.0	33.509	12.51	26.43	9.52	108.0
				50.0	33.500	11.63	26.38	13.91	35.0
				100.0	33.509	10.34	26.36	19.39	
				185.0	34.009	7.98	26.77	30.28	
				300.0	34.116	7.44	26.87	33.24	
				400.0	34.132	6.90	26.90	35.23	

APPENDIX C

Computer Programs

```
FORTRAN IV G LEVEL  21              MAIN              DATE = 80183         12/56/37            PAGE 0001

      C
      C      TABULAR DATA COMPILER
      C
             REAL MLAT,MLON,NO3,PO4,SST,ATP,CHLA,SPD,SUM,DIST,RNOPO,
            1MLATA,MLONA,NO3A,PO4A,SSTA,ATPA,CHLAA,SPDA
             INTEGER DLAT,DLON,TIND,TIME,FINI,START,LINE,
            1DLATA,DLONA,TINDA,TIMEA
             DIMENSION DLAT(2000),MLAT(2000),DLON(2000),MLON(2000),TIND(2000),
            1NO3(2000),PO4(2000),SST(2000),ATP(2000),CHLA(2000),TIME(2000),
            2SPD(2000),DLATA(1000),MLATA(1000),DLONA(1000),MLONA(1000),
            3TINDA(1000),NO3A(1000),PO4A(1000),SSTA(1000),ATPA(1000),
            4CHLAA(1000),TIMEA(1000),SPDA(1000)
             DATA DLAT,MLAT,DLON,MLON,TIND,NO3,PO4,SST,ATP,CHLA,TIME/2000*0,
            12000*0.,2000*0,2000*0.,2000*0,2000*0.,2000*0.,2000*0.,2000*0.,
            22000*0.,2000*0/
             DATA SPD/2000*0./
      C
      C
             DO 10 I=1,1000
             READ (5,100) TIMEA(I),DLATA(I),MLATA(I),DLONA(I),MLONA(I),
            1TINDA(I),SPDA(I)
             TINDA(I) = TINDA(I) + 2
             START=I
             IF(TIMEA(I).EQ.9999) GO TO 20
          10 CONTINUE
          20 FINI=START+1000
             DO 30 I=START,FINI
             READ (5,200) NO3A(I),PO4A(I),SSTA(I),TINDA(I),ATPA(I),CHLAA(I)
             TINDA(I) = TINDA(I) + 2
             J=I-1
             IF (NO3A(I).EQ.99.99) GO TO 40
          30 CONTINUE
          40 FINI=J
             LINE=TINDA(J)
             DO 50 K=START,FINI
             L=TINDA(J)
             TIND(L)=TINDA(J)
             NO3(L)=NO3A(J)
             PO4(L)=PO4A(J)
             SST(L)=SSTA(J)
             ATP(L)=ATPA(J)
             CHLA(L)=CHLAA(J)
             J=J-1
          50 CONTINUE
             START=START-1
             J=START
             DO 60 K=1,START
             L=TINDA(J)
             DLAT(L)=DLATA(J)
             MLAT(L)=MLATA(J)
             DLON(L)=DLONA(J)
             MLON(L)=MLONA(J)
             TIME(L)=TIMEA(J)
             SPD(L)=SPDA(J)
             J=J-1
          60 CONTINUE
             DIST=.617333
             SUM=0.
             I=2
             DO 95 L=1,20
          70 WRITE (6,300)
             DO 80 K=1,50
             IF (DLAT(I) .GT. 0) GO TO 86
          71 SUM=SUM+DIST
             WRITE (6,400) SUM
          72 IF (SST(I) .GT. 0.) WRITE (6,1300) SST(I)
          73 IF(NO3(I).EQ.0.) WRITE (6,500)
          74 IF(NO3(I).GT.0.) WRITE (6,600) NO3(I)
          75 IF(PO4(I).EQ.0.) WRITE (6,700)
          76 IF(PO4(I).GT.0.) WRITE (6,800) PO4(I)
          77 RNOPO=0.
          78 IF(NO3(I).GT.0..AND.PO4(I).GT.0.) RNOPO=NO3(I)/PO4(I)
          79 IF(RNOPO.GT.0.) WRITE (6,900) RNOPO
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```
   81 IF(ATP(I).GT.0.) WRITE (6,1000) ATP(I)
   82 IF(CHLA(I).GT.0.) WRITE (6,1100) CHLA(I)
   83 WRITE (7,1400) TIME(I),CLAT(I),MLAT(I),DLON(I),MLON(I),TIND(I),
     1SUM,NO3(I),PO4(I),RNOPO,ATP(I),CHLA(I),SST(I)
      I=I+2
   84 IF(I.GT.LINE) GO TO 90
   85 GO TO 80
   86 DIST=SPD(I)*.0617333
      SUM=SUM+DIST
      WRITE (6,1200) TIME(I),CLAT(I),MLAT(I),DLON(I),MLON(I),SUM
      GO TO 72
   80 CONTINUE
   55 CONTINUE
  100 FORMAT (I4,6X,I2,F5.1,3X,I3,F5.1,11X,I4,3X,F4.1)
  200 FORMAT (2X,F5.2,5X,F5.2,5X,F5.2,3X,I4,3X,F7.2,F7.2)
  300 FORMAT (1H1///////////32X,'R/V ACANIA',T48,'                    ',T70,
     1'CHEMICAL MESOSCALE CRUISE    I' /// 16X,'TIME',4X,'LATITUDE',2X,
     2'LONGITUDE',2X,'DISTANCE',4X,'NO3',6X,'PO4',5X,'NUTR.RATIO',5X,
     3'ATP',6X,'CHL A',4X,'TEMP'/ 18X,'GMT',6X,'NORTH',6X,'WEST',3X,
     4'NM',7X,'UM',7X,'UM',7X,'NO3/PO4',7X,'NG/L',5X,'MG/M3',4X,'DEG C')
  400 FORMAT (T45,F5.1)
  500 FORMAT ('+',T55,'--.--')
  600 FORMAT ('+',T55,F5.2)
  700 FORMAT ('+',T66, '--.--')
  800 FORMAT ('+',T68, F5.2)
  900 FORMAT ('+',T79, F4.1)
 1000 FORMAT ('+',T91,F6.1)
 1100 FORMAT ('+',T101,F5.2)
 1200 FORMAT (T15,I4,T27,I2,F5.1,3X,I3,F5.1,4X,F5.1)
 1300 FORMAT ('+',T110,F5.2)
 1400 FORMAT (I4,2(I4,F5.1,1X),1X,I4,2X,F5.1,2(2X,F5.2),2X,F4.1,2X,
     1F6.1,2(2X,F5.2))
 2000 FORMAT (2(I4,3X),2(F5.2,3X))
   90 STOP
      END
```

```
C
C     TABULAR DATA COMPILER W/RATP
C
      REAL MLAT,MLON,NO3,PO4,SST,ATP,CHLA,SPD,SUM,DIST,NNOPC,
     1MLATA,MLONA,NO3A,PO4A,SSTA,ATPA,CHLAA,SPDA,RATPA,RATP
      INTEGER DLAT,DLON,TIND,TIME,FINI,START,LINE,
     1DLATA,DLONA,TINDA,TIMEA
      DIMENSION DLAT(2500),MLAT(2500),DLON(2500),MLON(2500),TIND(2500),
     1NO3(2500),PO4(2500),SST(2500),ATP(2500),CHLA(2500),TIME(2500),
     2SPD(2500),DLATA(1275),MLATA(1275),DLONA(1275),MLONA(1275),
     3TINDA(1275),NO3A(1275),PO4A(1275),SSTA(1275),ATPA(1275),
     4CHLAA(1275),TIMEA(1275),SPDA(1275),RATP(2500),RATPA(1275)
      DATA DLAT,MLAT,DLON,MLON,TIND,NO3,PO4,SST,ATP,CHLA,TIME/2500*0,
     12500*0.,2500*0,2500*0.,2500*0,2500*0.,2500*0.,2500*0.,2500*0.,
     22500*0.,2500*0/
      DATA SPD,RATP/2500*0.,2500*0./
C
C
      DO 10 I=1,1250
      READ (5,100) TIMEA(I),DLATA(I),MLATA(I),DLONA(I),MLONA(I),
     1TINDA(I),SPDA(I)
      TINDA(I) = TINDA(I)-50
      START=I
      IF(TIMEA(I).EQ.9999) GO TO 20
   10 CONTINUE
   20 FINI=START+1250
      DO 30 I=START,FINI
      READ (5,200) NO3A(I),PO4A(I),SSTA(I),TINDA(I),ATPA(I),CHLAA(I),
     1RATPA(I)
      TINDA(I) = TINDA(I)-50
      J=I-1
      IF (NO3A(I).EQ.99.99) GO TO 40
   30 CONTINUE
   40 FINI=J
      LINE=TINDA(J)
      DO 50 K=START,FINI
      L=TINDA(J)
      TIND(L)=TINDA(J)
      NO3(L)=NO3A(J)
      PO4(L)=PO4A(J)
      SST(L)=SSTA(J)
      ATP(L)=ATPA(J)
      RATP(L)=RATPA(J)
      CHLA(L)=CHLAA(J)
      J=J-1
   50 CONTINUE
      START=START-1
      J=START
      DO 60 K=1,START
      L=TINDA(J)
      DLAT(L)=DLATA(J)
      MLAT(L)=MLATA(J)
      DLON(L)=DLONA(J)
      MLON(L)=MLONA(J)
      TIME(L)=TIMEA(J)
      SPD(L)=SPDA(J)
      J=J-1
   60 CONTINUE
      DIST=.0173333
      SUM=0.
      I=2
      DO 99 L=1,25
   70 WRITE (6,300)
      DO 90 K=1,50
      IF (DLAT(I) .GT. 0) GO TO 88
   71 SUM=SUM+DIST
      WRITE (6,400) SUM
   72 IF (SST(I) .GT. 0.) WRITE (6,1300) SST(I)
   73 IF(NO3(I).EQ.0.) WRITE (6,500)
   74 IF(NO3(I).GT.0.) WRITE (6,600) NO3(I)
   75 IF(PO4(I).EQ.0.) WRITE (6,700)
   76 IF(PO4(I).GT.0.) WRITE (6,800) PO4(I)
   77 NNOPC=0.
```

```
0059        78 IF(NO3(I).GT.0..AND.PO4(I).GT.0.) RNCPO=NO3(I)/PO4(I)
0060        79 IF(RNCPO.GT.0.) WRITE (6,900) RNCPO
0061        81 IF(ATP(I).GT.0.) WRITE (6,1000) ATP(I)
0062        82 IF(CHLA(I).GT.0.) WRITE (6,1100) CHLA(I)
0063        87 IF(RATP(I) .GT. 0.) WRITE(6,1500) RATP(I)
0064        83 WRITE (7,1400) TIME(I),CLAT(I),MLAT(I),DLON(I),MLON(I),TIND(I),
              1SUM,NO3(I),PO4(I),RNCPO,ATP(I),CHLA(I),SST(I)
0065           I=I+2
0066        84 IF(I.GT.LINE) GO TO 90
0067        85 GO TO 80
0068        86 DIST=SPD(I)*.0617333
0069           SUM=SUM+DIST
0070           WRITE (6,1200) TIME(I),CLAT(I),MLAT(I),DLON(I),MLON(I),SUM
0071           GO TO 72
0072        80 CONTINUE
0073        95 CONTINUE
0074       100 FORMAT (I4,6X,I2,F5.1,3X,I3,F5.1,11X,I4,9X,F4.1)
0075       200 FORMAT (2X,F5.2,5X,F5.2,5X,F5.2,2X,I4,10X,F7.2,F7.2,5X,F4.2)
0076       300 FORMAT (1H1/////////32X,'R/V ACANIA',T48,'                ',T70,
              1'CHEMICAL MESOSCALE (CRUISE     )' /// 13X,'TIME',4X,'LATITUDE',2X,
              2'LONGITUDE',2X,'DISTANCE',4X,'NO3',6X,'PO4',5X,'NUTR.RATIO',5X,
              3'ATP',T105,'CHL A',4X,'TEMP'/ 13X,'GMT',6X,'NORTH',6X,'WEST',8X,
              4'KM',7X,'UM',7X,'UM',7X,'NO3/PO4',7X,'NG/L',T105,'MG/M3',4X,
              5'DEG C')
0077       400 FORMAT (T44,F5.1)
0078       500 FORMAT ('+',T54,'--.--')
0079       600 FORMAT ('+',T54,F5.2)
0080       700 FORMAT ('+',T63, '--.--')
0081       800 FORMAT ('+',T63, F5.2)
0082       900 FORMAT ('+',T74, F4.1)
0083      1000 FORMAT ('+',T86,F6.1)
0084      1100 FORMAT ('+',T105,F5.2)
0085      1200 FORMAT (T14,I4,T22,I2,F5.1,3X,I3,F5.1,4X,F5.1)
0086      1300 FORMAT ('+',T114,F5.2)
0087      1400 FORMAT (I4,2(I4,F5.1,1X),1X,I4,2X,F5.1,2(2X,F5.2),2X,F4.1,2X,
              1F6.1,2(2X,F5.2))
0088      1500 FORMAT ('+',T97,F4.2)
0089      2000 FORMAT (2(I4,3X),2(F5.2,3X))
0090        90 STOP
0091           END
```

```
                C
                C      TABULAR DATA FOR DEPTH SELECT PROG
                C
                C
0001                   REAL DEPTH,TEMP,NO3,PO4,ATP,CHLA,MLAT,MLON,SAL,PHAEO
0002                   INTEGER STAT,DLAT,TIME,FLAT,FLON,LINE
0003                   DIMENSION TIME(100),DEPTH(100,12),TEMP(100,12),NO3(100,12),
                      1PO4(100,12),ATP(100,12),CHLA(100,12),TIME(100),DLAT(100),
                      2DLON(100),MLAT(100),MLON(100),SAL(100,12),PHAEO(100,12)
0004                   DIMENSION SIGMAT (100,12)
0005                   STAT=0
0006                   DO 20 I=1,100
0007                   TIME(I)=0
0008                   DLAT(I)=0
0009                   MLAT(I)=0.
0010                   DLON(I)=0
0011                   MLON(I)=0.
0012                   DO 10 J=1,12
0013                   DEPTH(I,J)=0.
0014                   SAL(I,J)=0.
0015                   TEMP(I,J)=0.
0016                   NO3(I,J)=0.
0017                   PO4(I,J)=0.
0018                   PHAEO(I,J)=0.
0019                   ATP(I,J)=0.
0020                   CHLA(I,J)=0.
0021               10  CONTINUE
0022               20  CONTINUE
                C
0023                   DO 30 I=1,7
0024                   READ (5,100) TIME(I),DLAT(I),MLAT(I),DLON(I),MLON(I)
0025               30  CONTINUE
0026               35  DO 40 I=1,7
0027                   READ (5,200) (DEPTH(I,J),J=1,7)
0028                   READ (5,200) (SAL(I,J),J=1,7)
0029                   READ (5,200) (TEMP(I,J),J=1,7)
0030                   READ (5,200) (NO3(I,J),J=1,7)
0031                   READ (5,200) (ATP(I,J),J=1,7)
0032               40  CONTINUE
0033                   CALL SIGMA (7,7,SAL,TEMP,SIGMAT)
0034               60  WRITE (6,300)
0035                   DO 75 K=1,7
0036                   WRITE(6,400) K,TIME(K),DLAT(K),MLAT(K),DLON(K),MLON(K)
0037                   DO 70 J=1,7
0038                   WRITE (6,500) DEPTH(K,J),SAL(K,J),TEMP(K,J)
0039                   IF (NO3(K,J) .GT. 0.) WRITE (6,600) NO3(K,J)
0040               67  IF (ATP(K,J) .GT. 0.) WRITE (6,800) ATP(K,J)
0041               70  CONTINUE
0042               75  CONTINUE
0043              100  FORMAT (I4,6X,I3,F5.1,3X,I3,F5.1)
0044              200  FORMAT (7F6.3)
0045              300  FORMAT(1H1,//////////32X,'S/V ACANIA',T48,
                      1'28 NOV / 3 DEC',T71,'CHEMICAL MESOSCALE (CRUISE X)'///
                      224X,'DEPTH',5X,'SALINITY',6X,'TEMP',8X,'NO3',6X,'PO4',5X,
                      3'METERS',7X,'O/OO',5X,'ATP',6X,'CHL A'/26X,'M',9X,'PPT',8X,'DEG C',7X,
                      4'UM',9X,'UM',7X,'NO3/PO4',7X,'NG/L',5X,'MG/M3')
0046              400  FORMAT (24X,'STATION ',I2,4X,'TIME ',I4,' GMT',4X,'LATITUDE ',I2,
                      1F5.1,' NORTH',4X,'LONGITUDE ',I3,F5.1,' WEST')
0047              500  FORMAT (T25,F5.1,T36,F6.3,T48,F5.2)
0048              600  FORMAT ('+',T59,F5.2)
0049              700  FORMAT ('+',T70,F5.2)
0050              800  FORMAT ('+',T93,F6.1)
0051              900  FORMAT ('+',T103,F5.2)
0052             1000  FORMAT ('+',T81,F5.2)
0053               90  STOP
0054                   END
```

```
      SUBROUTINE SIGMA (M,N,SAL,TEMP,SIGMAT)
      DIMENSION SAL(100,12),TEMP(100,12),SIGMAT(100,12)
      WRITE (6,1300)
 1300 FORMAT (1H1///30X,'STA LVL   SALINITY    TEMPERATURE    SIGMA-T')
      DO 2 I=1,M
      DO 2 J=1,N
      CL=(SAL(I,J)-.03)/1.805
      SIGO=6.96E-5*CL*CL*CL-4.57E-3*CL*CL+1.4708*CL-.093
      T=TEMP(I,J)
      TALM=(T-3.98)*(T-3.98)*(T+283.)
      TOLNCM=503.57*(T+67.26)
      A=4.7867-98.185E-3*T+10.843E-4*T*T
      AT=A*T*1.E-3
      B=18.03-.8164*T+1.667E-2*T*T
      BT=B*T*1.E-6
      S1=(SIGO-.1324)*BT-AT+1.
      S2=SIGO+.1324
      SIGMAT(I,J)=TALM/TOLNCM+S1*S2
      WRITE (6,1400) I,J,SAL(I,J),TEMP(I,J),SIGMAT(I,J)
 1400 FORMAT (30X,2(I3,1X),2F3.3(12.3))
    2 CONTINUE
      RETURN
      END
```

```
      C
      C     LEAST SQUARES BEST FIT SCHOOL CLCK
      C
      C
            INTEGER ENDV
            REAL*8 NC3,PC4,SST,TITLE,XREC,YREG,DELX,DELY,SLCPE,B,XCBS,YCBS
            DIMENSION NC3(1000),PC4(1000),SST(1000),TITLE(10),XREC(1000),
           1YREG(1000),DELX(1000),DELY(1000),XOBS(1000),YCBS(1000)
            DATA NC3,PC4,SST,TITLE,XREC,YREC,DELX,DELY,XCBS,YOBS/1000*0.D0,
           11000*0.D0,1000*0.D0,10*' ',1000*0.D0,1000*0.D0,1000*0.D0,1000*0.D0,
           21000*0.D0,1000*0.D0,1000*0.D0/
      C
            J=0
            DO 10 K=1,1000
            READ (5,100) ENDV,NC3(K),PC4(K),SST(K)
          1 IF (ENDV .EQ. 99) GO TO 20
          2 J=J+1
         10 CONTINUE
         20 L=1
            DO 30 K=1,J
            IF (NO3(K) .LE. 0.D0 .OR. SST(K) .LE. 0.D0) GO TO 30
         22 XOBS(L)=SST(K)
            YOBS(L)=NC3(K)
            L=L+1
         30 CONTINUE
            L=L-1
            READ (5,200) TITLE
            CALL NCRLSC (L,XOBS,YOBS,TITLE,XREG,YREG,DELX,DELY,SLOPE,B)
            CALL CORREL (L,XOBS,YOBS)
            L=1
            DO 40 K=1,J
            IF (PO4(K) .LE. 0.D0 .OR. SST(K) .LE. 0.D0) GO TO 40
         32 XOBS(L)=SST(K)
            YOBS(L)=PC4(K)
            L=L+1
         40 CONTINUE
            L=L-1
            READ (5,200) TITLE
            CALL NCRLSC (L,XOBS,YOBS,TITLE,XREG,YREG,DELX,DELY,SLOPE,B)
            CALL CORREL (L,XOBS,YOBS)
            L=1
            DO 50 K=1,J
            IF (PO4(K) .LE. 0.D0 .OR. SST(K) .LE. 0.D0 .OR. NO3(K) .LE. 0.D0)
           1 GO TO 50
         42 XOBS(L)=SST(K)
            YOBS(L)=NC3(K)/PC4(K)
            L=L+1
         50 CONTINUE
            L=L-1
            READ (5,200) TITLE
            CALL NCRLSC (L,XOBS,YOBS,TITLE,XREG,YREG,DELX,DELY,SLOPE,B)
            CALL CORREL (L,XOBS,YOBS)
            L=1
            DO 60 K=1,J
            IF (NO3(K) .LE. 0.D0 .OR. PO4(K) .LE. 0.D0) GO TO 60
         52 XOBS(L)=PC4(K)
            YOBS(L)=NC3(K)
            L=L+1
         60 CONTINUE
            L=L-1
            READ (5,200) TITLE
            CALL NCRLSC (L,XOBS,YOBS,TITLE,XREG,YREG,DELX,DELY,SLOPE,B)
            CALL CORREL (L,XOBS,YOBS)
        100 FORMAT (I2,3(F5.2,5X))
        200 FORMAT (10A8)
            STOP
            END
```

```
FORTRAN IV G LEVEL  21            CORREL          DATE = 80183        11/23/14           PAGE 0001

              SUBROUTINE CORREL (M,XOBS,YOBS)
              REAL*8 XOBS(1000),YOBS(1000),XYSUM,XSUM,YSUM,X2SUM,Y2SUM,A,B,C
              INTEGER*4 M
              XYSUM=0.0D0
              XSUM=0.0D0
              YSUM=0.0D0
              X2SUM=0.0D0
              Y2SUM=0.0D0
              DO 10 I=1,M
              XYSUM=XOBS(I)*YOBS(I)+XYSUM
              XSUM=XOBS(I)+XSUM
              YSUM=YOBS(I)+YSUM
              X2SUM=(XOBS(I)**2)+X2SUM
              Y2SUM=(YOBS(I)**2)+Y2SUM
           10 CONTINUE
              A=(DFLOAT(M)*X2SUM)-(XSUM**2)
              B=(DFLOAT(M)*Y2SUM)-(YSUM**2)
              C=(DFLOAT(M)*XYSUM)-(XSUM*YSUM)
              R=C/DSQRT(A*B)
              WRITE (6,20) R
           20 FORMAT (// 5X,'ESTIMATE OF THE POPULATION CORRELATION COEFFICIENT
             1= ',1PD24.14)
              RETURN
              END
```

```
                C
                C      GRAPHIC REPRESENTATION SOURCE DECK
                C
                C
0001                   REAL DIST,NO3,PO4,RNOPO,SST
0002                   DIMENSION DIST(1000),NO3(1000),PO4(1000),RNOPO(1000),SST(1000),
                      1X(1000),Y(1000)
0003                   DATA DIST,NO3,PO4,RNOPO,SST/1000*0.,1000*0.,1000*0.,1000*0.,
                      11000*0./
0004                   DATA X,Y/1000*0.,1000*0./
                C
0005                   J=0
0006                   DO 10 K=1,1000
0007                   READ (5,100) DIST(K),NO3(K),PO4(K),RNOPO(K),SST(K)
0008                   IF (DIST(K) .EQ. 999.9) GO TO 11
0009                 1 J=J+1
0010                10 CONTINUE
0011                11 READ (5,200) XMIN,XMAX
0012                   DO 60 I=1,15
0013                   CALL PLOTG(DIST,SST,J,1,1,3,
                      1'ELAPSED DISTANCE (KM)',21,'NUTRIENTS (UM) / TEMPERATURE (DEG C)',
                      236,XMIN,XMAX,6.,18.,21.,6.)
0014                   DO 30 K=1,J
0015                   Y(K)=(NO3(K)*.333)+8.
0016                30 CONTINUE
0017                   CALL PLOTG (DIST,Y,J,2,1,1,
                      1'ELAPSED DISTANCE (KM)',21,'NUTRIENTS (UM) / TEMPERATURE (DEG C)',
                      236,XMIN,XMAX,6.,18.,21.,6.)
0018                   DO 40 K=1,J
0019                   Y(K)=(PO4(K)*3.333)+8.
0020                40 CONTINUE
0021                   CALL PLOTG (DIST,Y,J,3,1,2,
                      1'ELAPSED DISTANCE (KM)',21,'NUTRIENTS (UM) / TEMPERATURE (DEG C)',
                      236,XMIN,XMAX,6.,18.,21.,6.)
0022                   CALL PLOTG (DIST,SST,J,1,1,3,
                      1'ELAPSED DISTANCE (KM)',21,'NUTRIENT RATIO (NO3/PO4) / TEMPERATURE
                      2 (DEG C)',40,XMIN,XMAX,8.,18.,21.,8.)
0023                   DO 50 K=1,J
0024                   Y(K)=(RNOPO(K)*.666)+8.
0025                50 CONTINUE
0026                   CALL PLOTG (DIST,Y,J,2,1,1,
                      1'ELAPSED DISTANCE (KM)',21,'NUTRIENT RATIO (NO3/PO4) / TEMPERATURE
                      2 (DEG C)',40,XMIN,XMAX,8.,18.,21.,8.)
0027                   READ (5,200) XMIN,XMAX
0028                   IF (XMIN .GT. DIST(J)) GO TO 61
0029                60 CONTINUE
0030                61 CALL PLOT (0.,0.,0.,0,999)
0031               100 FORMAT (31X,F5.1,2(2X,F5.2),2X,F4.1,17X,F5.2)
0032               200 FORMAT (2F5.1)
0033                   STOP
0034                   END
```

```
FORTRAN IV G LEVEL  21                MAIN              DATE = 80177          15/03/22                PAGE 0001

              C
              C      GRAPHIC REPRESENTATION OVER DEPTH SOURCE DECK
              C
              C
0001                 REAL NO3,N
0002                 DIMENSION DEPTH(7),SAL(7),TEMP(7),NO3(7),D(49),S(49),T(49),N(49)
0003                 DIMENSION ATP(7),X(7),Y(7),A(49),X1(49),Y1(49)
              C
0004                 L=1
0005                 DO 30 K=1,7
0006                 READ (5,200) DEPTH
0007                 READ (5,200) SAL
0008                 READ (5,200) TEMP
0009                 READ (5,200) NO3
0010                 READ (5,200) ATP
0011             200 FORMAT (7F6.3)
0012                 DO 10 J=1,7
0013                 SAL(J)=(SAL(J)-32.3)*5.
0014                 X(J)=-TEMP(J)
0015                 TEMP(J)=20.-((TEMP(J)-6.5)*1.205)
0016                 NO3(J)=((NO3(J)-.7)*.265)+20.
0017                 Y(J)=NO3(J)-10.
0018                 ATP(J)=40.-(ATP(J)*.055)
0019              10 CONTINUE
0020                 CALL PLOTG (DEPTH,SAL,7,1,1,5,
                    1'DEPTH (M)',9,
                    2'STATION    :  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
                    3 / ATP (NG/L)',78,0.,400.,0.,40.,6.,16.)
0021                 CALL PLOTG (DEPTH,TEMP,7,2,1,3,
                    1'DEPTH (M)',9,
                    2'STATION    :  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
                    3 / ATP (NG/L)',78,0.,400.,0.,40.,6.,16.)
0022                 CALL PLOTG (DEPTH,NO3,7,2,1,1,
                    1'DEPTH (M)',9,
                    2'STATION    :  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
                    3 / ATP (NG/L)',78,0.,400.,0.,40.,6.,16.)
0023                 CALL PLOTG (DEPTH,ATP,7,2,1,4,
                    1'DEPTH (M)',9,
                    2'STATION    :  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
                    3 / ATP (NG/L)',78,0.,400.,0.,40.,6.,16.)
0024                 CALL PLOTG (X,SAL,7,1,1,5,
                    1'TEMPERATURE (DEG C)',19,
                    2'STATION    :  SALINITY (PPT) / NITRATE (UM)',43,-15.,-6.,0.,20.,
                    36.,6.)
0025                 CALL PLOTG (X,Y,7,2,1,1,
                    1'TEMPERATURE (DEG C)',19,
                    2'STATION    :  SALINITY (PPT) / NITRATE (UM)',43,-15.,-6.,0.,20.,
                    36.,8.)
0026                 DO 20 I=1,7
0027                 D(L)=-DEPTH(I)
0028                 S(L)=SAL(I)
0029                 T(L)=TEMP(I)
0030                 N(L)=NO3(I)
0031                 A(L)=ATP(I)
0032                 X1(L)=X(I)
0033                 Y1(L)=Y(I)
0034                 L=L+1
0035              20 CONTINUE
0036              30 CONTINUE
0037                 L=1
0038              31 DO 40 K=1,7
0039                 DEPTH (K)=D(L)
0040                 SAL(K)=S(L)
0041                 TEMP(K)=T(L)
0042                 NO3(K)=N(L)
0043                 ATP(K)=A(L)
0044                 L=L+1
0045              40 CONTINUE
0046                 IF (L .NE. 8) GO TO 50
0047              41 CALL PLOTG (SAL,DEPTH,7,1,1,5,
                    1'  COMPOSITE:  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
                    2 / ATP (NG/L)',78,'DEPTH (M)',9,0.,40.,-400.,0.,40.,15.)
0048                 GO TO 60
```

```
0049      50 CALL PLOTG (SAL,DEPTH,7,2,1,5,
            1'  COMPOSITE:  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
            2 / ATP (NG/L)',78,'DEPTH (M)',9,0.,40.,-400.,0.,40.,15.)
0050      60 CALL PLOTG (TEMP,DEPTH,7,2,1,3,
            1'  COMPOSITE:  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
            2 / ATP (NG/L)',78,'DEPTH (M)',9,0.,40.,-400.,0.,40.,15.)
0051         CALL PLOTG (NO3,DEPTH,7,2,1,1,
            1'  COMPOSITE:  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
            2 / ATP (NG/L)',78,'DEPTH (M)',9,0.,40.,-400.,0.,40.,15.)
0052         CALL PLOTG (ATP,DEPTH,7,2,1,4,
            1'  COMPOSITE:  SALINITY (PPT) / TEMPERATURE (DEG C) / NITRATE (UM)
            2 / ATP (NG/L)',78,'DEPTH (M)',9,0.,40.,-400.,0.,40.,15.)
0053         IF (L .NE.50) GO TO 31
0054      61 L=1
0055      62 DO 70 K=1,7
0056         X(K)=-X1(L)
0057         Y(K)=Y1(L)
0058         SAL(K)=S(L)
0059         L=L+1
0060      70 CONTINUE
0061         IF (L .NE. 8) GO TO 80
0062      71 CALL PLOTG (SAL,X,7,1,1,5,
            1'  COMPOSITE:  SALINITY (PPT) / NITRATE (UM)',43,
            2'TEMPERATURE (DEG C)',19,0.,20.,6.,15.,20.,15.)
0063         GO TO 90
0064      80 CALL PLOTG (SAL,X,7,2,1,5,
            1'  COMPOSITE:  SALINITY (PPT) / NITRATE (UM)',43,
            2'TEMPERATURE (DEG C)',19,0.,20.,6.,15.,20.,15.)
0065      90 CALL PLOTG (Y,X,7,2,1,1,
            1'  COMPOSITE:  SALINITY (PPT) / NITRATE (UM)',43,
            2'TEMPERATURE (DEG C)',19,0.,20.,6.,15.,20.,15.)
0066         IF (L .NE. 50) GO TO 62
0067      91 CALL PLOT (0.0,0.0,999)
0068         STOP
0069         END
```

```
C
C     CORRELATION TEST SOURCE DECK
C
C
      REAL DIST,NO3,PO4,RNOPO,SST
      DIMENSION DIST(1000),NO3(1000),PO4(1000),RNOPO(1000),SST(1000),
     1X(1000),Y(1000)
      DATA DIST,NO3,PO4,RNOPO,SST/1000*0.,1000*0.,1000*0.,1000*0.,
     11000*0./
      DATA X,Y/1000*0.,1000*0./
C
      J=0
      DO 10 K=1,1000
      READ (5,100) DIST(K),NO3(K),PO4(K),RNOPO(K),SST(K)
      IF (DIST(K) .EQ. 999.9) GO TO 11
    1 J=J+1
   10 CONTINUE
   11 XMAX=3.
      YMAX=30.
      L=1
      DO 20 K=1,J
      IF (RNOPO(K) .EQ. 0.) GO TO 20
   12 X(L)=PO4(K)
      Y(L)=NO3(K)
      L=L+1
   20 CONTINUE
      L=L-1
      CALL PLOTG (X,Y,L,1,0,1,'PHOSPHATE (UM)',14,'NITRATE (UM)',12,0.,
     1XMAX,0.,YMAX,18.,18.)
      XMIN=8.
      XMAX=16.
      L=1
      DO 30 K=1,J
      IF (NO3(K) .LE. 0. .OR. SST(K) .LE. 0.) GO TO 30
   21 Y(L)=NO3(K)
      X(L)= SST(K)
      L=L+1
   30 CONTINUE
      L=L-1
      CALL PLOTG (X,Y,L,1,0,1,
     1'TEMPERATURE (DEG C)',19,'NITRATE (UM)',12,
     2XMIN,XMAX,0.,YMAX,18.,18.)
      YMAX=3.
      L=1
      DO 40 K=1,J
      IF (PO4(K) .LE. 0. .OR. SST(K) .LE. 0.) GO TO 40
   31 Y(L)=PO4(K)
      X(L)= SST(K)
      L=L+1
   40 CONTINUE
      L=L-1
      CALL PLOTG (X,Y,L,1,0,1,
     1'TEMPERATURE (DEG C)',19,'PHOSPHATE (UM)',14,
     2XMIN,XMAX,0.,YMAX,18.,18.)
      YMAX=15.
      L=1
      DO 50 K=1,J
      IF (RNOPO(K) .LE. 0. .OR. SST(K) .LE. 0.) GO TO 50
   41 Y(L)=RNOPO(K)
      X(L)= SST(K)
      L=L+1
   50 CONTINUE
      L=L-1
      CALL PLOTG (X,Y,L,1,0,1,
     1'TEMPERATURE (DEG C)',19,'NUTRIENT RATIO (NO3/PO4)',24,
     2XMIN,XMAX,0.,YMAX,18.,18.)
      CALL PLOT (0.,0.,0.0,999)
  100 FORMAT (31X,F5.1,2(2X,F5.2),2X,F4.1,17X,F5.2)
      STOP
      END
```

```
FORTRAN IV G LEVEL  21                MAIN                DATE = 80213          15/10/20              PAGE 0001

                 C
                 C      CONVERSION OF GEOGRAPHIC POSITIONS TO SIMPLE MATHEMATICAL SURFACE
                 C      MAXIMUM NUMBER OF POINTS ABLE TO BE PROCESSED = 1000
                 C
      0001              REAL DLAT,MLAT,DLON,MLON,SPD(1250),Y,C,Y(1250),X(1250)
      0002              REAL NO3(1250),PO4(1250),ASCFL(1250),ATP(1250),CHLA(1250)
      0003              REAL SST(1250),XL(1250),YL(1250)
      0004              REAL X1(1250),X2(1250),X3(1250),X4(1250)
      0005              REAL Y1(1250),Y2(1250),Y3(1250),Y4(1250)
      0006              REAL SPD1(1250),SPD2(1250),SPD3(1250),SPD4(1250)
      0007              INTEGER TIME(1250),TIMEL(1250)
      0008              DIMENSION FLOCL(1250),ORIN(1250)
      0009              DATA X1,X2,X3,X4,Y1,Y2,Y3,Y4,SPD1,SPD2,SPD3,SPD4/
                       11250*0.,1250*0.,1250*0.,1250*0.,1250*0.,1250*0.,1250*0.,1250*0.,
                       21250*0.,1250*0.,1250*0.,1250*0./
                 C
                 C      READ GEO-POSITION DATA
                 C
      0010              J=0
      0011              DO 6 I=1,100
      0012              READ (5,100) TIME(I),DLAT,MLAT,DLON,MLON,TIMEL(I),SPD(I)
      0013              IF (TIME(I) .EQ. 9999) GO TO 7
                 C
                 C      COMPUTE DISTANCE IN KILOMETERS FROM ORIGIN SPECIFIED
                 C
      0014            1 D=DLAT-36.
      0015              M=MLAT-0.6
      0016              Y(I)=((D*60.)+M)*1.852
      0017              D=DLON-122.
      0018              M=MLON-2.
      0019              X(I)=-((D*60.)+M)*1.4983
      0020              J=J+1
                 C
                 C      OUTPUT GEO-POSITIONS AND X,Y COORDINATES
                 C
      0021              WRITE (6,200) TIME(I),DLAT,MLAT,DLON,MLON,X(I),Y(I)
      0022            6 CONTINUE
      0023            7 J=J-1
                 C
                 C      COMPUTE DISTANCE BETWEEN KNOWN POINTS BY:
                 C             TIME-SPEED ALGORITHM
                 C             TRIGONOMETRIC ALGORITHM
                 C
      0024              DO 8 I=1,J
      0025              T=TIME(I+1)-TIME(I)
      0026              D=T*SPD(I)*.030867
      0027              A=X(I+1)-X(I)
      0028              B=Y(I+1)-Y(I)
      0029              C2=(A*A)+(B*B)
      0030              C=SQRT(C2)
                 C
                 C      DEVELOP FACTOR TO EQUATE BOTH DISTANCE SOLUTIONS
                 C
      0031              IF (D .NE. 0.) FLOCL(I)=C/D
                 C
                 C      COMPUTE ACUTE ANGLE FROM TRUE SOUTH TO NEXT KNOWN POINT
                 C
      0032            2 AB=999.
      0033              IF (B .NE. 0.) AB=A/B
      0034            3 ORIN(I)=ATAN(AB)
      0035            8 CONTINUE
      0036              K=0
      0037              L=0
                 C
                 C      READ TAB DATA CARDS
                 C      STORE NUMBER OF DISCRETE SAMPLES READ UNDER BLOCK 'K'
                 C      WHERE GEO-POSITION OF SAMPLE IS KNOWN APPLY ANGLE AND DISTANCE
                 C      FACTOR TO DATA ALONGTRACK TILL ANOTHER GEO-POSITION IS READ
                 C
      0038              DO 14 I=1,1250
      0039              READ (5,400) LLAT,TIMEA,DIST,NO3(I),PO4(I),ASCFL(I),ATP(I),
                       1CHLA(I),SST(I)
      0040              IF (DIST .EQ. 999.9) GO TO 15
```

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```
    4 K=K+1
      IF (LLAT .EQ. 0.) GO TO 12
    5 L=L+1
      ANGLE=CNTN(L)
      ORIGIN=DIST
      X1(I)=X(L)
      Y1(I)=Y(L)
      GO TO 14
C
C     FOR A POINT THAT IS NOT DEFINED BY CPD-POSITION:
C     COMPUTE DISTANCE FROM KNOWN POINT IN THE X- AND Y-DIRECTION
C
   13 C=(DIST-ORIGIN)*FLOAT(L)
      A=C*SIN(ANGLE)
      B=C*COS(ANGLE)
C
C     ADD INCREMENTAL DISTANCES TO LAST KNOWN POSITION TO ARRIVE AT
C     X,Y COORDINATE OF SAMPLE
C
      X1(I)=X(L)-A
      Y1(I)=Y(L)-B
      IF (Y(L) .LT. Y(L+1)) X1(I)=X(L)+A
   17 IF (Y(L) .LT. Y(L+1)) Y1(I)=Y(L)+B
   20 IF ((Y(L) .EQ. Y(L+1)) .AND. (X(L) .LT. X(L+1))) X1(I)=X(L)+A
   14 CONTINUE
C
C     PUNCH ONLY SIGNIFICANT DATA  AND X,Y COORDINATES
C
   15 L=0
      L1=0
      L2=0
      L3=0
      L4=0
      DO 22 I=1,K
      IF (SST(I) .LE. 0.) GO TO 30
    9 L=L+1
      X(L)=X1(I)
      Y(L)=Y1(I)
      SPE(L)=SST(I)
   30 IF (NO3(I) .LE. 0.1) GO TO 31
   10 L1=L1+1
      X1(L1)=X1(I)
      Y1(L1)=Y1(I)
      SPE1(L1)=NO3(I)
   31 IF (PO4(I) .LE. 0.1) GO TO 32
   11 L2=L2+1
      X2(L2)=X1(I)
      Y2(L2)=Y1(I)
      SPE2(L2)=PO4(I)
   32 IF (PHOTO(I) .LE. 0.) GO TO 33
   12 L3=L3+1
      X3(L3)=X1(I)
      Y3(L3)=Y1(I)
      SPE3(L3)=PHOTO(I)
   33 IF (AIR(I) .LE. 0.) GO TO 22
   16 L4=L4+1
      X4(L4)=X1(I)
      Y4(L4)=Y1(I)
      SPE4(L4)=AIR(I)
   22 CONTINUE
      WRITE (6,300) L,L1,L2,L3,L4
      DO 23 I=1,L2
      WRITE (6,200) X(I),Y(I),SPE(I),X1(I),Y1(I),SPE1(I),
     1X2(I),Y2(I),SPE2(I),X3(I),Y3(I),SPE3(I)
      WRITE (7,200) X(I),Y(I),SPE(I),X1(I),Y1(I),SPE1(I),
     1X2(I),Y2(I),SPE2(I),X3(I),Y3(I),SPE3(I)
   23 CONTINUE
      DO 24 I=1,L4
      WRITE (6,700) X4(I),Y4(I),SPE4(I)
      WRITE (7,700) X4(I),Y4(I),SPE4(I)
   24 CONTINUE
C
  100 FORMAT (I4,2X,2(3X,F4.1),F4.1,(1X,I4,9X,F4.1))
```

```
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0100           200 FORMAT (5X,4(F5.2,F6.2))
0101           300 FORMAT (10X,I2,2(5X,F5.1),2(5X,F10.3))
0102           400 FORMAT (5X,F4.1,16X,I4,2X,F5.1,2(2X,F5.2),2X,F4.1,2X,F6.1,
                  12(2X,F5.2))
0103           500 FORMAT (//10X,5(I4,5X)//)
0104           600 FORMAT (4(2F7.3,F5.2))
0105           700 FORMAT (5X,2F7.3,F7.1)
              C
0106               STOP
0107               END


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0001               REAL*8 TITLE(12),XAX/' X IN KM'/,YAX/' Y IN KM'/
0002               DIMENSION IE(35),CONTUR(30),NB(1),NA(10),X(500),Y(500),SPD(500)
0003               DATA IE/1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,
                  123,24,25,26,27,28,29,30,31,32,33,34,35/
0004               DATA NR,CF,XS,YS/1,.2,-6.3492,-6.3492/
0005               DATA NA/1,0,0,0,1,0,0,1,0,0/
0006               DATA TITLE/12*'  '/
0007               READ (5,300) NE,NC
0008               READ (5,400) CONTUR
0009               L=0
0010               DO 1 I=1,500
0011               READ (5,200) X(I),Y(I),SPD(I)
0012               IF (X(I) .EQ. 999.9) GO TO 3
0013               WRITE (6,500) X(I),Y(I),SPD(I)
0014             2 L=L+1
0015             1 CONTINUE
0016             3 CALL CONISO(X,Y,SPD,L,IE,NR,NE,CONTUR,NC,CF,XS,YS,TITLE,XAX,
                  1YAX,NA,IER)
0017               WRITE (6,100) IER
0018           100 FORMAT (10X,'CONISO ERROR CODE = ',I2)
0019           200 FORMAT (57X,2F7.3,F5.2)
0020           300 FORMAT (2I5)
0021           400 FORMAT (15F5.1/15F5.1)
0022           500 FORMAT (10X,2(F7.3,5X),F5.2)
0023               STOP
0024               END
```

```
C
C     10 MINUTE AVERAGED GRADIENTS OF NUTRIENTS/TEMPERATURE
C     WITH RESPECT TO DISTANCE SOURCE DECK
C
C
      REAL NO3,NH4
      DIMENSION DIST(1000),NO3(1000),PO4(1000),SST(1000),DT(1000),
     1DN(1000),DP(1000),DX(1000),DTDX(1000),DNDX(1000),DPDX(1000),
     2ZERO(1000),DSUM(1000)
      DIMENSION D(1000),B(1000),P(1000),T(1000)
      DATA D,B,P,T/1000*0.,1000*0.,1000*0.,1000*0./
      DO 1 I=1,1000
      DIST(I)=0.
      NO3(I)=0.
      PO4(I)=0.
      SST(I)=0.
      DT(I)=-99.
      DN(I)=-99.
      DP(I)=-99.
      DX(I)=-99.
      DTDX(I)=-99.
      DNDX(I)=-99.
      DPDX(I)=-99.
      ZERO(I)=0.
      DSUM(I)=0.
    1 CONTINUE
C
      N=0
      DO 2 I=1,1000
      READ (5,100) D(I),B(I),P(I),T(I)
      IF (D(I) .GE. 999.9) GO TO 3
  111 N=N+1
    2 CONTINUE
    3 N=N-4
      DO 80 K=1,N
      J=K
      SUM1=0.
      SUM2=0.
      SUM3=0.
      SUM4=0.
      Z1=0.
      Z2=0.
      Z3=0.
      DO 10 I=1,5
      IF (T(J) .GT. 0.)   SUM1=SUM1+T(J)
    4 IF (B(J) .GT. 0.)   SUM2=SUM2+B(J)
    5 IF (P(J) .GT. 0.)   SUM3=SUM3+P(J)
    6 IF (T(J) .GT. 0.) Z1=Z1+1.
    7 IF (B(J) .GT. 0.) Z2=Z2+1.
    8 IF (P(J) .GT. 0.) Z3=Z3+1.
    9 SUM4=SUM4+D(J)
      J=J+1
   10 CONTINUE
      IF (Z1 .GT. 0.) SST(K)=SUM1/Z1
   77 IF (Z2 .GT. 0.) NO3(K)=SUM2/Z2
   78 IF (Z3 .GT. 0.) PO4(K)=SUM3/Z3
   79 DIST(K)=SUM4/5.
      WRITE (7,600) DIST(K),SST(K),NO3(K),PO4(K)
   80 CONTINUE
      M=N-1
      DO 20 I=1,M
      IF (SST(I+1) .GT. 0. .AND. SST(I) .GT. 0.)
     1DT(I)=SST(I+1)-SST(I)
   14 IF (NO3(I+1) .GT. 0. .AND. NO3(I) .GT. 0.)
     1DN(I)=NO3(I+1)-NO3(I)
   15 IF (PO4(I+1) .GT. 0. .AND. PO4(I) .GT. 0.)
     1DP(I)=PO4(I+1)-PO4(I)
   16 DX(I)=DIST(I+1)-DIST(I)
      IF (DX(I) .EQ. 0.) GO TO 20
   17 IF (DT(I) .NE. -99.) DTDX(I)=DT(I)/DX(I)
   18 IF (DN(I) .NE. -99.) DNDX(I)=DN(I)/DX(I)
   19 IF (DP(I) .NE. -99.) DPDX(I)=DP(I)/DX(I)
   20 CONTINUE
```

```
      YMAX=0.
      YMAX1=0.
      YMAX2=0.
      TMAX=0.
      NMAX=0.
      PMAX=0.
      CPMAX=0.
      DO 30 I=1,J
      IF (DTDX(I) .NE. -99.) YMAX1=ABS(DTDX(I))
   23 IF (DNDX(I) .NE. -99.) YMAX2=ABS(DNDX(I))
   24 IF (DPDX(I) .NE. -99.) CPMAX=ABS(DPDX(I))
   25 CYMAX=YMAX2
      IF(YMAX1 .GT. YMAX2) CYMAX=YMAX1
   26 IF (CYMAX .GT. YMAX) YMAX=CYMAX
   27 IF (CPMAX .GT. PMAX) PMAX=CPMAX
   28 IF (YMAX2 .GT. NMAX) NMAX=YMAX2
   29 IF (YMAX1 .GT. TMAX) TMAX=YMAX1
   30 CONTINUE
      WRITE (6,600)
      WRITE (6,300)
      WRITE (6,400) D(1),B(1),F(1),T(1)
      WRITE (6,400) D(2),B(2),F(2),T(2)
      WRITE (6,500) D(3),DIST(1),E(3),NO3(1),P(3),PO4(1),T(3),SST(I)
      M=N+2
      DO 60 I=4,M
      J=I-2
      K=I-3
      WRITE (6,200) D(I),DIST(J),DX(K),B(I),NO3(J),DN(K),P(I),PO4(J),
     1DF(K),T(I),SST(J),DT(K),DNDX(K),DPDX(K),DTDX(K)
   60 CONTINUE
      WRITE (6,400) D(N+3),E(N+3),F(N+3),T(N+3)
      WRITE (6,400) D(N+4),E(N+4),F(N+4),T(N+4)
      WRITE (6,700) TMAX,NMAX,PMAX
      J=N-1
      K=1
      L=1
      M=1
      DO 70 I=1,J
   64 IF (DTDX(I) .NE. -99.) DT(M)=DTDX(I)
   65 IF (DTDX(I) .NE. -99.) M=M+1
   66 IF (DNDX(I) .NE. -99.) DN(L)=DNDX(I)
   67 IF (DNDX(I) .NE. -99.) L=L+1
   68 IF (DPDX(I) .NE. -99.) DF(K)=DPDX(I)
   69 IF (DPDX(I) .NE. -99.) K=K+1
   70 CONTINUE
      K=K-1
      L=L-1
      M=M-1
      CALL HISTF (DT,M,20)
      CALL HISTF (DN,L,20)
      CALL HISTF (DF,K,20)
  100 FORMAT (31X,F5.1,2(2X,F5.2),23X,F5.2)
  200 FORMAT (/6X,15(F7.2,1X))
  300 FORMAT (8X,'DIST     DIST    D(DIST)      NO3       NO3    D(NO3)     PO4
     1    PO4    D(PO4)   TEMP      TEMP    D(TEMP)   DN/DX    DP/DX    DT/DX')
  400 FORMAT (/6X,4(F7.2,17X))
  500 FORMAT (/8X,4(2(F7.2,1X),8X))
  600 FORMAT (1H1,// '                CRUISE (    )')
  700 FORMAT (// 8X,'MAXIMUM CHANGE IN TEMPERATURE FOR A ONE KILOMETER D
     1ISTANCE = ',F5.2 // 8X,'MAXIMUM CHANGE IN NITRATE FOR A ONE KILOME
     2TER DISTANCE = ',F5.2 // 8X,'MAXIMUM CHANGE IN PHOSPHATE FOR A ONE
     3 KILOMETER DISTANCE = ',F5.2)
  800 FORMAT (4F7.2)
      STOP
      END
```

```
               C
               C      FILTERED 10 MINUTE AVERAGED GRADIENTS OF NUTRIENTS/TEMPERATURE
               C      WITH RESPECT TO DISTANCE SOURCE DECK
               C
               C
0001                  REAL NO3,NMAX
0002                  DIMENSION DIST(1000),NO3(1000),PO4(1000),SST(1000),DT(1000),
                     1DN(1000),DP(1000),DX(1000),DTDX(1000),DNDX(1000),DPDX(1000),
                     2ZERO(1000),DSUM(1000)
0003                  DIMENSION D(1000),B(1000),P(1000),T(1000)
0004                  DATA D,B,P,T/1000*0.,1000*0.,1000*0.,1000*0./
0005                  DO 1 I=1,1000
0006                  DIST(I)=0.
0007                  NO3(I)=0.
0008                  PO4(I)=0.
0009                  SST(I)=0.
0010                  DT(I)=-99.
0011                  DN(I)=-99.
0012                  DP(I)=-99.
0013                  DX(I)=-99.
0014                  DTDX(I)=-99.
0015                  DNDX(I)=-99.
0016                  DPDX(I)=-99.
0017                  ZERO(I)=0.
0018                  DSUM(I)=0.
0019                1 CONTINUE
               C
0020                  N=0
0021                  DO 2 I=1,1000
0022                  READ (5,100) D(I),B(I),P(I),T(I)
0023                  IF (D(I) .GE. 999.9) GO TO 3
0024              111 N=N+1
0025                2 CONTINUE
0026                3 N=N-4
0027                  DO 80 K=1,N
0028                  J=K
0029                  SUM1=0.
0030                  SUM2=0.
0031                  SUM3=0.
0032                  SUM4=0.
0033                  Z1=0.
0034                  Z2=0.
0035                  Z3=0.
0036                  DO 10 I=1,5
0037                  IF (T(J) .GT. 0.)    SUM1=SUM1+T(J)
0038                4 IF (B(J) .GT. 0.)    SUM2=SUM2+B(J)
0039                5 IF (P(J) .GT. 0.)    SUM3=SUM3+P(J)
0040                6 IF (T(J) .GT. 0.) Z1=Z1+1.
0041                7 IF (B(J) .GT. 0.) Z2=Z2+1.
0042                8 IF (P(J) .GT. 0.) Z3=Z3+1.
0043                9 SUM4=SUM4+D(J)
0044                  J=J+1
0045               10 CONTINUE
0046                  IF (Z1 .GT. 0.) SST(K)=SUM1/Z1
0047               77 IF (Z2 .GT. 0.) NO3(K)=SUM2/Z2
0048               78 IF (Z3 .GT. 0.) PO4(K)=SUM3/Z3
0049               79 DIST(K)=SUM4/5.
0050               80 CONTINUE
0051                  J=N-1
0052                  DO 20 I=1,J
0053                  IF (SST(I+1) .GT. 0. .AND. SST(I)) .GT. 0.)
                     1DT(I)=SST(I+1)-SST(I)
0054               14 IF (NO3(I+1) .GT. 0. .AND. NO3(I)) .GT. 0.)
                     1DN(I)=NO3(I+1)-NO3(I)
0055               15 IF (PO4(I+1) .GT. 0. .AND. PO4(I)) .GT. 0.)
                     1DP(I)=PO4(I+1)-PO4(I)
0056               16 DX(I)=DIST(I+1)-DIST(I)
0057                  IF (DX(I) .EQ. 0.) GO TO 20
0058               17 IF (DT(I) .NE. -99.) DTDX(I)=DT(I)/DX(I)
0059               18 IF (DN(I) .NE. -99.) DNDX(I)=DN(I)/DX(I)
0060               19 IF (DP(I) .NE. -99.) DPDX(I)=DP(I)/DX(I)
0061               20 CONTINUE
0062                  READ (5,800) A1,A2,B1,B2,C1,C2
```

```
      WRITE (6,600)
      WRITE (6,200)
      WRITE (6,900) DIST(1)
      DO 90 I=1,J
      WRITE (6,900) DIST(I+1)
      IF ((DTDX(I) .LE. A2 .AND. DTDX(I) .GE. A1) .OR.
     1(DTDX(I) .EQ. -99.)) DTDX(I)=0.
   85 IF ((DNDX(I) .LE. B2 .AND. DNDX(I) .GE. B1) .OR.
     1(DNDX(I) .EQ. -99.)) DNDX(I)=0.
   86 IF ((DPDX(I) .LE. C2 .AND. DPDX(I) .GE. C1) .OR.
     1(DPDX(I) .EQ. -99.)) DPDX(I)=0.
   87 IF (DTDX(I) .NE. 0.) WRITE (6,300) DTDX(I)
   88 IF (DNDX(I) .NE. 0.) WRITE (6,400) DNDX(I)
   89 IF (DPDX(I) .NE. 0.) WRITE (6,500) DPDX(I)
   90 CONTINUE
      YMAX=0.
      YMAX1=0.
      YMAX2=0.
      TMAX=0.
      NMAX=0.
      PMAX=0.
      CPMAX=0.
      DO 30 I=1,J
      IF (DTDX(I) .NE. -99.) YMAX1=ABS(DTDX(I))
   23 IF (DNDX(I) .NE. -99.) YMAX2=ABS(DNDX(I))
   24 IF (DPDX(I) .NE. -99.) CPMAX=ABS(DPDX(I))
   25 CYMAX=YMAX2
      IF(YMAX1 .GT. YMAX2) CYMAX=YMAX1
   26 IF (CYMAX .GT. YMAX) YMAX=CYMAX
   27 IF (CPMAX .GT. PMAX) PMAX=CPMAX
   28 IF (YMAX2 .GT. NMAX) NMAX=YMAX2
   29 IF (YMAX1 .GT. TMAX) TMAX=YMAX1
   30 CONTINUE
      J=N-1
      DO 40 I=1,J
      TEMP=DTDX(I)*YMAX/TMAX
      DTDX(I)=TEMP
      TEMP=DNDX(I)*YMAX/NMAX
      DNDX(I)=TEMP
      IF (PMAX .GT. 0.) TEMP=DPDX(I)*YMAX/PMAX
   32 IF (PMAX .LE. 0.) TEMP=DPDX(I)
   33 DPDX(I)=TEMP
      DSUM(I)=DIST(I)+(DX(I)/2.)
   40 CONTINUE
      YMIN=-YMAX
      READ (5,700) XMIN,XMAX
      DO 50 I=1,15
      CALL PLOTG (DSUM,DTDX,J,1,1,3,
     1'ELAPSED DISTANCE (KM)',21,'GRADIENTS OF NUTRIENTS & TEMPERATURE O
     2VER DISTANCE',50,XMIN,XMAX,YMIN,YMAX,21.,8.)
      CALL PLOTG (DSUM,DNDX,J,2,1,1,
     1'ELAPSED DISTANCE (KM)',21,'GRADIENTS OF NUTRIENTS & TEMPERATURE O
     2VER DISTANCE',50,XMIN,XMAX,YMIN,YMAX,21.,8.)
      CALL PLOTG (DSUM,DPDX,J,3,1,2,
     1'ELAPSED DISTANCE (KM)',21,'GRADIENTS OF NUTRIENTS & TEMPERATURE O
     2VER DISTANCE',50,XMIN,XMAX,YMIN,YMAX,21.,8.)
      CALL PLOTG (DIST,ZERO,N,3,1,0,
     1'ELAPSED DISTANCE (KM)',21,'GRADIENTS OF NUTRIENTS & TEMPERATURE O
     2VER DISTANCE',50,XMIN,XMAX,YMIN,YMAX,21.,8.)
      READ (5,700) XMIN,XMAX
      IF (XMIN .GT. DIST(N)) GO TO 51
   50 CONTINUE
   51 CALL PLOT (0.,0.,0.,0.,999)
  100 FORMAT (3X,F5.1,2(2X,F5.2),23X,F5.2)
  200 FORMAT (// 52X,'DIST',T61,'DT/DX    DN/DX    DP/DX'//)
  300 FORMAT ('+',T59,F7.2)
  400 FORMAT ('+',T67,F7.2)
  500 FORMAT ('+',T75,F7.2)
  600 FORMAT (1H1,//'           CRUISE (    )')
  700 FORMAT (2F5.1)
  800 FORMAT (6F7.4)
  900 FORMAT (/ 50X,F7.2)
      STOP
```

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